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Table of Contents

ORIGINAL ARTICLES— PAGE.

The Beattie-Smith Lectures—I: "The Treatment of Insanity by the General Practitioner", by JOHN K. ADEY, O.B.E., M.B., B.S. .. 111

"Disabilities of the Knee Joint", by L. O. BETTS, M.B., B.S., M.Ch. .. 116

"Carbon Dioxide: Some Observations on Its Use and Abuse During Anæsthesia", by DOUGLAS G. RENTON, M.B., B.S. .. 121

"The Detoxicating Properties of Sodium Thiosulphate in 'Avertin' Intoxication: An Experimental Study", by ADOLPH BOLLIGER, Ph.D. .. 125

"Diabetic Coma", by EWEN DOWNIE, M.D., M.R.C.P. 131

REPORTS OF CASES—

"Fatal Snake-Bite", by H. H. LEE, M.B., Ch.M., F.R.A.C.S. .. 133

REVIEWS—

Biological Chemistry .. 133

Allergy .. 134

NOTES ON BOOKS, CURRENT JOURNALS AND NEW APPLIANCES—

Fiji and Its People .. 134

The Journal of Thoracic Surgery .. 134

LEADING ARTICLES—

The Spirit of Research .. 135

CURRENT COMMENT—

Diabetes and Its Complications .. 136

Treatment in Poliomyelitis .. 137

The Late Robert Henry Todd .. 137

ABSTRACTS FROM CURRENT MEDICAL LITERATURE— PAGE.

Gynæcology .. 138

Obstetrics .. 139

SPECIAL ARTICLES ON AIDS TO DIAGNOSIS—

Basal Metabolism Estimation .. 140

BRITISH MEDICAL ASSOCIATION NEWS—

Scientific .. 141

Nominations and Elections .. 143

POST-GRADUATE WORK—

Lectures in Melbourne .. 143

CORRESPONDENCE—

Sterilization of the Unfit .. 143

An Alleged Action of Orally Administered Insulin 143

OBITUARY—

Daniel Gilbert Miller Teague .. 143

BOOKS RECEIVED .. 144

DIARY FOR THE MONTH .. 144

MEDICAL APPOINTMENTS .. 144

MEDICAL APPOINTMENTS VACANT, ETC. .. 144

MEDICAL APPOINTMENTS: IMPORTANT NOTICE 144

EDITORIAL NOTICES .. 144

The Beattie-Smith Lectures.[1]

(UNIVERSITY OF MELBOURNE.)

THE TREATMENT OF INSANITY BY THE GENERAL PRACTITIONER.

By JOHN K. ADEY, O.B.E., M.B., B.S. (Melbourne),
Medical Superintendent, Hospital for the Insane, Sunbury.

LECTURE I.

THE late Dr. Beattie-Smith, in whose memory these lectures are given, was a pupil of Sir Thomas Clouston, the greatest alienist of the end of the nineteenth century, possibly of all time. His work has lately been superseded by the work of the modern German school under Kraepelin, but, whilst the work of Kraepelin is the more scientific, in my opinion we still have much to learn from Clouston, and, from the point of view of practical value to the general physician, the work of Sir Thomas Clouston still stands unequalled.

Tonight I shall try to put before you what can be done for the mentally afflicted, not from the specialist's standpoint, but strictly from the point of view of the general practitioner. That point of view is important because the general practitioner sees the patient in the earliest stage of his illness; he knows the family history, the peculiar idiosyncrasies of the patient and, still more important, those of his family; he knows the conditions under which the patient lives; and has at his fingers' ends much valuable information which can be obtained with difficulty, if at all, by the specialist in insanity.

I should here like to point out the relation of the practitioner to the mental hospital. When I was a student it was so much of a truism that it was never pointed out, that the duty of a doctor was to cure his patient. Unfortunately, when a case of insanity is being considered, this duty is complicated by a

[1] Delivered on October 19 and 22, 1931.

duty to the patient's friends and to the general public. Not infrequently these duties clash, and what may be the best for the patient may not be the best for his friends or neighbours. Early certification will place a patient in a public or private asylum and give him the best possible chance of efficient treatment, for there is no doubt that treatment in a private house, even with two efficient nurses, is not adequate to deal with all cases. On the other hand there is no doubt that certification of a patient who can be cured at home is unfortunate for the patient, and the friends will be better pleased if the stigma of certification has not been placed upon him. It is most unfortunate that the suspicion and dislike of the mental hospital by the general public have been handed down from the dark ages by the anxiety of unscrupulous novelists to sell thrillers, and that by no means can the general public be persuaded to overcome their dislike to a mental hospital and to look on it the same way as they do the general hospital or the hospital for infectious diseases.

It is impossible to overcome this prejudice rapidly, but I hope with the assistance of the profession, by educating the public and by improving our own work (I am speaking now for the asylum doctor) that this prejudice will be eventually overcome. Most people consider that once a patient is in a mental hospital he can never expect to get out again. It appears almost impossible to persuade them that a hospital exists for the good of its patients, and that it is the desire of the staff of a mental hospital to get its patients out, not to keep them in.

I candidly admit that the treatment of insanity has not made the progress that general medicine has made in the twentieth century. One of the reasons is the inherent difficulty of the subject. We receive little help from the pathologist or bacteriologist and the psychologist does his best to lead us astray. The anatomist and the physiologist ignore our existence. All the same, an immense amount of research is continually being undertaken. One cannot take up a copy of *The Journal of Mental Science*, to mention only one of the many periodicals devoted to the study of mental disease, without being struck by the immense amount of labour that is being devoted to the subject both by bio-chemists and by psychologists. I have no doubt that one day someone of the mental calibre of Lord Lister will arise and will do for psychiatry what Lister did for surgery, but until then we can only do our best with the knowledge we have and ask everyone to assist us in obtaining more.

I shall suppose that a general practitioner is called to attend a case of insanity in a private house, in which the people can afford a trained nurse and the necessary food and attention. The poor have to go to a mental hospital as they would go to a general hospital for physical disease, and the very wealthy are able to afford the assistance of the specialist. My object is to show that much can be done for the insane patient in a middle class family without sending him to a mental hospital.

The first difficulty confronting every doctor is that of diagnosis. I shall get over this difficulty by the simple method of ignoring it, and shall diagnose according to age, that is, by taking each form of insanity likely to arise at each age, making suggestions for the treatment and if possible the prognosis.

Congenital Mental Deficiency.

The first form of course is congenital mental deficiency. If you be called to see a child, aged two to fourteen years, and you suspect congenital deficiency, the first thing is to see that he is not a cretin. If there be any reasonable suspicion that you are dealing with a case of cretinism, thyreoid tablets must at once be given according to age. Start with 0·06 gramme (one grain) every day and work up to 0·6 gramme (ten grains) according to the progress of the child. Remarkable improvement occurs very rapidly and, provided that the mother keeps on with the treatment, the improvement is lasting.

We now come to the true congenital deficiency, not due to deficiency in the thyreoid gland. Be very careful in diagnosing congenital deficiency in a child under the age of five years. If you see a child under that age whom you suspect of deficiency on account of backwardness in walking or talking, remember that these children sometimes make very rapid progress in a few months. Possibly the child has been undernourished, is rhachitic, or there is a gross organic lesion to account for the condition.

When you are satisfied that you have a case of congenital deficiency to deal with, a very considerable amount can be done by an intelligent and devoted mother. If the child can be taught to be clean and to dress and feed himself, much has been done for the comfort of the mother and the whole family. If a child has a mental age of about six years he can be taught these things. For this purpose the clothes must be made as simply as possible, nothing to tie or button at the back. The child can be given pieces of cloth with buttons sewn on one piece and button-holes on the other, or two pieces of leather with eyelet holes in them and bootlaces, and can have these on the table and be shown how to thread them, and so can learn how to lace up his boots.

General principles for the future welfare of the child should be laid down, according to his intelligence and to his position in life. Remember, if he be the son of a farmer or living in the country, that many of these children make good farm hands, provided there is someone to supervise and direct them. Their schooling should be of a purely practical nature. Have them taught to milk, cut wood, carry water, or if they are girls, to clean floors, make beds, peel potatoes *et cetera*, but reading and writing are unnecessary. A few years ago the majority of the population of England were unable to read or write and lived very happy useful lives in spite of this. It is possibly advisable to try to teach the child to write his own name, even if he does not know the letters, as he may be required to sign documents. Even if he learned to read he would never read for pleasure or for information, and the time spent on teaching him would be merely thrown away.

Sometimes these children have remarkable aptitude in one direction and in such cases this must be taken advantage of to the uttermost. Each child must be

trained with the object of making its life as useful and happy as circumstances will allow, and allowing it to be as little nuisance to its friends and neighbours as possible.

At this point I should like to digress and to mention the marriage of cousins. The latest reports of eugenists on the subject seem to indicate that there is no danger in the marriage of cousins, provided that they come of healthy stock. A man of a tuberculous family marrying into a non-tuberculous family gives his children a reasonable chance to be non-tuberculous. A tuberculous man who marries a woman with a similar family history cannot be surprised if the children have the family failing. Consequently as cousins always have the same family tendencies, if this tendency be of the nature of hereditary disease like insanity, for eugenic reasons they should not marry.

The Nervous Child.

We now come to consider the subject of nervous children. I mean children between the ages of six and sixteen who suffer from night terrors, irritability, sleep walking, and who either work too hard at school or not at all. They are usually self absorbed and reticent, if punished they sulk, if not punished they become nuisances to themselves and to all around them. The schoolmaster and the parents are their worst enemies and competitive examinations are the invention of the devil. Both parents and schoolmasters are inclined to push the boy's cerebral activity to the utmost, the boy is afraid to protest and, from fear, takes to lying as a refuge. Lying produces punishment, which increases the fear and this increases the lying, till a vicious circle of increasing dread is established, night terrors ensue, and the child is threatened with the doctor.

After this suitable preparation he is taken to a physician and he looks upon the doctor as an ally of his parents and will act accordingly. The confidence of the boy is the first necessity, and for that reason remember that the child is your patient, his parents are not. Insist on seeing him alone and try to acquire his confidence; this can only be done by deserving it. The doctor will then frequently find that the child is living under mental torments that no adult person could stand for a week.

Having obtained the boy's confidence much can be done to alleviate his condition by altering his environment; but if the patient merely has his troubles increased by a bottle of Fellows' Syrup, which he abominates, he will slip into adolescent insanity and everyone will wonder why. I should like to suggest that in such cases for some young girls a woman doctor is useful, and if a man finds that he cannot make progress with a young girl of nervous temperament, a woman doctor will possibly be of the very greatest assistance in elucidating the difficulties.

Nervous children need an immense amount of watching, for it is from these cases that adolescent insanity will arise. One parent is usually hypochondriacal and helpless, the other worried and overworked. If the parents be wealthy the child may do well at boarding school, or may be better with, say, an uncle in the country. Sometimes they are worse at boarding school than at home, as they are unable to take their own parts in the rough and tumble of school life. The ideal treatment for children of this kind, aged about twelve years, would be to take them away from nervous parents, put them in charge of a kindly, but strong-willed person, preferably in the country, with plenty of good food and not much meat, and keep them away from school for a year. This treatment frequently gives them sufficient energy to tide them over the dangerous period of puberty; it should not be delayed in the hope that the child will grow out of the nervousness until the age of fourteen in girls, or sixteen in boys. If at these ages they are likely to break down into adolescent insanity, this danger is minimized if they are in good physical health, and is increased if they are undernourished physically and worried mentally.

Masturbation in Boys.

We now come to the subject of masturbation in boys. In my opinion this does no harm to the normal boy, except the harm that is done by unnecessary worry and the pernicious influence of quack literature. I was extremely sorry to see an article in a medical paper about two years ago, in which a doctor gave a lecture on the evils of masturbation before a mother's meeting. This is probably the worst possible place at which such a lecture could be given.

I do not mean to suggest that when a boy consults a doctor on the subject, the latter should treat the subject lightly; this will simply drive the boy into the arms of quacks, feeling that he has been misunderstood. To threaten the boy with evil results is worse than useless. This concentrates the boy's attention on the subject and a vicious circle, both physiological and psychical, is established. I think that masturbation probably accentuates the condition of a neurotic child. I believe that attention should be paid to the general condition rather than that any attempt should be made to remove the masturbation. As the neurotic condition improves, the desire for masturbation will disappear or become ineffective.

Epilepsy.

I shall now deal with epilepsy because three-fourths of all epileptics have their first fit before the age of twenty-five. If epilepsy occurs after the age of thirty, it is most probable that there is some gross lesion to account for it. I am aware that the majority of epileptics do not become insane, in fact many great men, such as Julius Cæsar, Mahomet, Swift and Swedenborg were reputed epileptics, but in spite of this historical evidence there is a general tendency for an epileptic to become mentally enfeebled. The rapidity of his enfeeblement is not proportionate to the number of his fits; some patients have several fits a week and still retain their mental powers, others have possibly one fit in several months and become rapidly enfeebled.

The treatment of the epileptic insane is extremely difficult. "Luminal", with or without bromides, is the best treatment. I give all epileptics "Luminal

sodium " in 0·03 gramme (one-half grain) doses four times a day, and give as little as is necessary to control the fits. It is very dangerous to stop the " Luminal " suddenly as the result is that the patient may go into a condition of *status epilepticus* if the drug is stopped for only twenty-four hours. The results are better if the " Luminal " is given in solution than in solid form, but it deteriorates if kept in solution longer than eight days. Too large a bottle must not be given and care must be taken that the supply can be replenished without any delay. For post-epileptic furor the best treatment is to leave the patient in a room by himself with sufficient supervision to see that he does not injure himself in a fit. If he becomes very violent, hyoscine, 1·3 milligrammes (one-fiftieth of a grain) should be injected. Whether an epileptic should be sent to an asylum depends entirely on his conduct. No better treatment can be carried out in an asylum than in a private house, but it is frequently impossible for him to live in the latter on account of post-epileptic violence, and when once an epileptic has been violent, there is always the possibility of a recurrence of the violence on some future occasion.

Adolescent Insanity.

Adolescent insanity comprising different varieties is particularly difficult to deal with. A boy or girl, aged fifteen to twenty-five, suddenly becomes erratic in conduct, hears voices talking to him, and seems to lose his grip on life. The prognosis is extremely difficult, some go steadily down hill and in a couple of years are chronic inmates of asylums, others recover and remain apparently well. To make matters more obscure, the prognosis is in no relation to the severity of the attack; in fact I think that the more insidious the onset, the worse the outlook. There is more hope if the patient be in bad physical condition at the onset of the attack, if his weight is below normal and his appetite poor. In these cases good food and rest will work wonders.

This type of patient is difficult to manage in a private house and has to be sent to an institution or to a private hospital. The conduct of these patients is so erratic that they need careful watching day and night, and although they are not as a rule actively violent, they cause much worry to their people. I have had experience of them in asylums only, and I think that I am unduly pessimistic, for probably the lighter forms are not seen by any but the general practitioner.

I make the following suggestions for home treatment, but whether this is feasible depends on the wealth, how many there are in the family, whether the family lives in town or country and similar circumstances.

The patient should be given mental and physical rest; patients showing physical debility should be kept in bed. Plenty of good food should be given, three ordinary meals a day and extras in the way of milk and eggs. Malt and cod-liver oil are useful. The bowels must, of course, be kept well open. If the patient is restless, bromides and chloral hydrate can be given, and the best sleeping draught is 8·0 mils (two fluid drachms) of paraldehyde.

The patient should be weighed every week, and if the weight does not increase the patient is not improving. If the weight does increase there should be an improvement in the mental condition at the same time. The scales are to the alienist what the clinical thermometer is to the physician, a mathematical estimate of the patient's condition. If the patient's mental condition does not improve with the increase of weight, the prognosis is not good. It is most inadvisable to recommend a sea voyage or a trip away from the patient's habitual surroundings; it does not improve his mental condition, it increases his fatigue, and it makes it much more difficult to deal with him if he becomes unmanageable. In that case the patient may have to be sent to an asylum in another State, away from his own people who have the greatest difficulty and expense in bringing him home again. When the patient has apparently recovered, a holiday in the country with a relative may be beneficial, but even then it should not be beyond motor-driving distance from home, so that, if necessary, he can be returned in a few hours.

For restlessness in these cases much good is done by prolonged warm baths. For this purpose the bath should be lined with blankets and pillows placed in it, the water should be at about 37·8° C. (100° F.), and the patient will often voluntarily remain in the bath for half an hour or more, and after being dried and put to bed, go quietly to sleep. For extreme restlessness amounting to violence, 0·6 to 1·3 milligrammes (one one-hundredth to one-fiftieth of a grain) of hyoscine given hypodermically is the best remedy; it is also very useful if the patient has to be transferred from place to place. Morphine in these cases, in fact in all restless forms of insanity, is quite useless.

Septic foci in the shape of decayed or unerupted teeth, septic tonsils, or infected sinuses must be attended to, but this applies more to general hygiene than to the treatment of insanity.

Insanity of Pregnancy.

Insanity of pregnancy is usually of mild type and frequently clears up before or soon after the birth. General treatment in the shape of rest, good food, sedatives if necessary, and above all, close and continuous watching, are essential. The question of causing an abortion is sometimes raised, but of course this should not be performed without a consultation with an obstetrician. From the point of view of the alienist, abortion is not advisable in uncomplicated cases as it only converts an insanity of pregnancy into an insanity of the puerperium. If the patient be very restless so as to exhaust herself, or be suffering from insomnia which hypnotics will not relieve, an abortion may be necessary, but as a general rule it is not called for by the mental symptoms only.

Insanity of the Puerperium.

Insanity of the puerperium is a more common condition. It usually commences within ten days of the confinement, and the patient shows symptoms of acute mania. Two good nurses are essential. The first principle is to preserve the patient's strength by plenty of liquid food, given in small quantities and

frequently. The milk should be peptonized, and all food should be as easily digestible as possible. Brandy should be given early in the treatment, especially if the patient's strength be failing. These patients often refuse their food, and then the stomach tube must be used without loss of time. See that the nurse accurately records the amount of food actually taken, not the amount poured out for the patient to take, as frequently the nurse may say the patient has had three meals, when she has had only half a cup of milk each time. Feeding by the stomach tube must be repeated every few hours, but fortunately these patients usually take their food after twenty-four to forty-eight hours of tube feeding.

Once the patient takes her food well, the rest is easy. Paraldehyde should be given for sleeplessness, bromides for restlessness. The child must be weaned at once as it is assisting to exhaust the mother. The nurse must be specially warned not to allow the mother to hold her child, and this is difficult to enforce, as when the mother improves slightly, she desires to hold her child, and her request is supported by the distracted relatives with statements that her recovery is retarded by the want of her child. The result is that when the mother has the child and the nurse's back is turned for an instant, owing to restlessness or to lack of attention, the mother throws the child on to the floor and its skull is fractured, with possibly a most undesirable domestic tragedy.

The general treatment of the confinement, attention to the breasts, lochia *et cetera*, are the same as in an ordinary case. Most patients with puerperal insanity recover completely in about three months. It is of course advisable for the mother to have no more children for at least five years.

A few of these patients seem to recover for a while and then appear to remain in a state of mild mental enfeeblement, the restlessness disappears, but there remains an apathetic condition, inability to concentrate the mind, and the patient is unable to look after her household duties. The late Dr. Lalor gave these patients vaccine injections, *Staphylococcus aureus* 600 millions, streptococci 100 millions, *Bacillus coli* 100 millions; he gave one dose every four days for three weeks, intermitting for about a month, and if there was no improvement he repeated the course of injections, giving double the dose. This vaccine can be obtained from the Commonwealth Serum Laboratories, and its use is often attended by excellent results. No patient should be allowed to sink into dementia without these injections being tried. I have had no opportunity of trying them in acute cases, but I should not hesitate to do so if the patient were not doing well under ordinary treatment.

Lactational Insanity.

Lactational insanity usually takes the form of melancholia and occurs more than six weeks after confinement. It occurs in women advanced in childbearing life, who are in poor circumstances and have had a hard struggle for existence. Their sentence in life has been "twenty years' hard labour, and frequent confinements". Such patients naturally do not lend themselves to treatment at home. Anything that can be done for them lies in the treatment of melancholia, which I shall deal with later, together with weaning of the child and improvement in the general health.

Alcoholism.

I shall now deal with the alcoholic insanities, and one of the first impressions we receive is that of the numerous forms that can be exhibited by insanity caused by alcoholism. *Delirium tremens*, Korsakoff's psychosis, alcoholic hallucinosis, alcoholic pseudoparesis, and mental enfeeblement can all be caused by over indulgence in liquor. The diagnosis is usually easily obtained by the past history, but here a word of warning must be given. All insanities in which there is a history of alcoholism are not necessarily caused by alcoholism. For instance a man feels the onset of melancholia, and prescribes for himself the only medicine he knows, to "buck him up", as he explains. This causes further depression and then further drinking, until the patient appears to be suffering from alcoholic insanity, when the drinking is really an effect, and not a cause of, the insanity. In these cases the wife will usually say that the patient used not to drink, but for the last three weeks he has been drinking heavily. Usually, with the exception of *delirium tremens*, it needs years of steady, not necessarily heavy, drinking to cause insanity.

Delirium tremens can usually be treated without difficulty if drugs are pushed in the beginning. About an ounce of brandy should be given for incipient *delirium tremens* and immediately after the patient is put to bed and given the following medicine.

Paraldehyde 16·0 mils (four fluid drachms).
Potassium bromide 2·0 grammes (thirty grains).
Chloral hydrate 2·0 grammes (thirty grains).
Tincture of digitalis 2·0 mils (thirty minims).
Water to 30·0 mils (one fluid ounce).

Give 120·0 mils (four fluid ounces) in a bottle and no more. The dose is 30·0 mils (one fluid ounce) and is given every two hours until the patient is asleep.

For a more violent case of *delirium tremens*, in which the condition is fully developed, give 30·0 mils (an ounce) of brandy, followed by 0·72 gramme (twelve grains) of barbitone, and in two hours another 30·0 mils of brandy and 0·6 gramme (ten grains) of barbitone. The patient goes to sleep after the first or second dose and wakes up with the restless stage passed. It is advisable that the patient should be kept in a darkened room and as free from external stimuli as possible. Tonics and good feeding complete the cure, and no more alcohol should be given.

The remaining types of alcoholism I shall treat together, as it is almost impossible to treat patients affected by them in a private house. The first essential, and the one that makes it impossible to treat these patients privately, is that they should get no more alcohol. The only patients to whom I give alcohol in the course of treatment are old men, say about seventy, who have been drinking for many years. The remainder are cut off alcohol in all forms, and care is taken to see that none is given in the medicines. *Liquor strychninæ* is given instead of tincture of *nux vomica*. The result is that many

of these cases clear up in a most satisfactory manner, the patients lose their suspicions and delusions, and after a few months are quite well. Unfortunately, however, they are always liable to have a recurrence of the insanity if, or rather when, they again start drinking. Other patients are left with a residue of mental enfeeblement, sometimes so severe that they are never able to return to work. It is difficult to say which patients are going to recover, and which will become chronically affected, but in my experience the acuter the onset, the more favourable the prognosis. I think this applies irrespective of age, as I have seen some comparatively old men recover, while some men under thirty have remained mentally enfeebled.

General Paralysis of the Insane.

General paralysis of the insane is another form of insanity which it is almost impossible to treat privately. This has been the subject of a previous lecture by Dr. Ellery, and I shall not mention the treatment now except to say that I am satisfied that the malarial treatment, that is, giving the patient an injection of blood containing *Plasmodium malariæ*, and thus causing a succession of malarial rigors, is the best treatment that has yet been found. The results put briefly are that 30% of patients recover, 30% improve, and the remainder are not improved.

Unfortunately most patients with general paralysis of the insane are sent to us after they have been ill for at least six months, and we should get much better results if they were treated earlier. Wagner Jauregg, who first instituted the treatment, says that we should be able to bring about 90% of remissions. I therefore appeal to the general profession to assist us by sending these patients for expert treatment as soon as possible.

The first sign is usually a change in the character of the patient. A respectable man suddenly becomes slovenly in his behaviour, careless in his work, irritable with his wife and children, and his wife will say that he does not seem himself. The wife may persuade him to see a doctor, and he will arrive at the consulting room and will explain that there is no need for him to come as he never felt better in his life. It is almost pathognomonic of general paralysis of the insane when a man says that he never felt better in his life. All general paralytics say this, even when they have only a few hours to live.

If a patient makes a statement of this sort and on examination he shows irregularity of, or sluggishness of the pupillary reactions and his reaction to the Wassermann test is positive, be very suspicions of general paralysis of the insane. Most general paralytics have delusions or may have exaltation, but do not think that a man is not a general paralytic because in his mental condition he appears sane. We are anxious to treat these patients before the mental symptoms develop. The question then arises what to do with a patient whom you suspect to be suffering from early general paralysis of the insane. If he can afford it, insist on a consultation with a specialist; if not, there is a clinic established for this type of patient in all the general hospitals in Melbourne.

Another reason why it is imperative that these patients should be caught early is that they are very likely to spend money beyond their means, possibly contract to buy a block of land, or to buy extravagant amounts of jewellery. The result is that their families may be left penniless at a time when they require money more than ever before.

DISABILITIES OF THE KNEE JOINT.[1]

By L. O. BETTS, M.B., B.S. (Adelaide), M.Ch. (Orth.) (Liverpool),
Adelaide.

THE knee joint is more frequently damaged, and more commonly affected by inflammatory lesions than any other joint.

I shall deal mainly with traumatic lesions. The importance of making every attempt to arrive at an exact diagnosis when the patient is first seen, cannot be too greatly stressed. There are too many patients who drift into a partial invalidity with the diagnosis of "synovitis", with consequently inadequate treatment.

History and Examination.

A very careful history should be taken. Get a detailed description of the production of the injury, letting the patient describe the accident in his own words, or better still, to reconstruct it. Special attention should be given to the position of the leg and foot, with the direction of the various strains and stresses placed on the limb at the time of the accident. Cross-examine closely as to the exact location of the initial pain, its intensity and duration, the details of any locking, and the time of the onset of the effusion. On examination note the posture, the presence of effusion, any abnormal mobility or limitation of movement, seeking particularly for lack of full extension and lateral mobility in extension, and making crucial ligament tests. A slight limitation of extension may be missed if the limb is not on a firm flat couch, and carefully compared with the other. Lateral movement is tested with the leg fully extended. The omission to observe this point is a common source of error. While testing the range of movement, note any grating, clicks, or snaps, and try to locate their origin. Points of tenderness are next sought, over the fat pads, the anterior end of the internal semilunar cartilage (first with the knee in extension and then in flexion), and over the lateral ligament.

Apart from these points the whole of the joint line should be carefully palpated in extension and flexion. All the synovial membrane and capsule (except the posterior third), the lateral ligaments, the fat pads, and the anterior two-thirds of the attachments of both semilunar cartilages, are available for direct palpation. By attention to anatomical detail the origin of tender points can be accurately determined. Wasting or lack of tone in the quadriceps muscles, especially the *vastus internus*, is of importance in doubtful or recurrent cases, in which also an X ray examination is necessary to exclude bony lesions.

[1] Read at a meeting of the South Australian Branch of the British Medical Association on October 29, 1931.

The common internal derangements of the knee following trauma are: (i) Simple traumatic synovitis; (ii) injury to the semilunar cartilages or their attachments; (iii) rupture or sprain of the lateral ligaments; (iv) injury or enlargement of the infrapatellar fat pads; (v) loose bodies; (vi) rupture of the crucial ligaments, or separation of the tibial spine. Of these, the first three are the most frequent.

Simple Synovitis.

Simple synovitis occurs after a blow, twist or a wrench, the latter producing a strain of some of the ligamentous or capsular supports, the site being indicated by local pain and tenderness. Effusion of synovial fluid of a varying amount takes place. The evidence of the site of these lesser lesions soon disappears, so should be carefully sought early. The more serious of internal derangements must be eliminated before any injury is treated as simple synovitis.

Injury to the Semilunar Cartilages.

Injury to the semilunar cartilages can, in a great number of instances, be diagnosed on the history alone. The typical case was accurately described by William Hey, in 1783:

> A violent internal rotation of the femur on the fixed tibia, or of an external rotation of the tibia on a fixed femur, with the joint in a position of flexion. This is followed by an immediate inability to fully straighten the knee, accompanied by an intense pain over the inner and anterior aspect of the joint, and followed in a few hours by synovitis which slowly disappears under treatment.

The above classical picture only requires tenderness over the attachment of the cartilage, to confirm the diagnosis. Injury to the internal lateral ligament sometimes accompanies this lesion; it is manifested by tenderness at the joint line or at the femoral or tibial insertion of the ligament, usually the former. Failure to obtain full extension of the joint is very suggestive of a damaged meniscus; forced extension producing pain over the anterior end would confirm those suspicions. A history of locking followed by a sudden unlocking with relief of pain is almost pathognomic. The unlocking must be definite.

Lesions of the posterior end of the internal meniscus are frequent. They are produced in the squatting or kneeling position, with internal or external rotation. The condition is sometimes known as "carpet layer's" cartilage. This does not present such a definite picture as the anterior lesion. The pain is not so severe, and is localized in the posterior part of the joint. There is usually more of a numbness or useless feeling, followed by tenderness over the joint line postero-internally. McMurray's method of examination may help to confirm the diagnosis of this type of lesion. The knee should be flexed completely, so that the heel rests as near the buttock as possible; the ankle is then grasped in the right hand, and the joint controlled by the left hand, with the thumb and forefinger firmly grasping it on either side at the joint level posteriorly, and behind the external and internal lateral ligaments respectively. The ankle is now twisted by the right hand, so that the knee is rotated internally, and externally to its fullest extent. If a lesion of the external cartilage or of the posterior portion of the internal cartilage is present, a definite click can be felt under the finger or thumb of the left hand.

The following case illustrates how the posterior half of a meniscus may give trouble after the anterior half has been removed.

> E.M., a male aged 27 years, had been subjected to operation seven years previously for the removal of a cartilage. Four months before I saw him he had been struck heavily on the inside of the knee and effusion had followed. Several times since the leg had given way under him and he had suffered from pain at the back of the knee. Four days before examination, when walking, he felt a sudden pain in the knee on the inner side and behind. The knee locked in nearly full extension, and the limb felt useless. Marked effusion followed, with tenderness over the postero-internal joint line. There was the usual anterior arthrotomy scar from his previous operation. The posterior half of the cartilage was later removed at operation.

Lesions of the external meniscus are produced with indefinite symptoms similar to those of the posterior end of the internal, but referred to the external part of the joint. Tenderness is not so definitely localized, on account of the loose attachment of this cartilage to the tibia. In subacute or chronic cases a definite click or "clunk" during the last few degrees of voluntary extension is commonly heard or felt.

A knowledge of the various types of injury to cartilages will help explain the variations in severity and types of attacks. The most common lesion is the longitudinal split or "bucket handle"; a tearing away of the anterior end from its attachments to the tibia is the next most frequent. The latter is the only lesion in which repair is possible, by reattachment to the bone. In all other splits or tears repair cannot take place, the meniscus being avascular, except at the outer rim. Tears of the free margin give little more than a "catch" in the joint, with very little reaction and pain, as no damage to sensitive or vascular tissue results. The nearer the tears to the rim or the greater the tongue of cartilage torn free, the greater the pull on the sensitive attachments when the fragment locks, and the greater the consequent reaction.

Rupture and Sprain of the Lateral Ligaments.

Sprain of the internal lateral ligaments follows an injury in which the knee is extended, and a sudden force is applied to the outer side. There is immediate acute pain over the inner side of the joint, with rapid effusion but no locking. The maximum points of tenderness are over the ligaments at the joint line, when only the short deep fibres are torn, or at its origin from the internal femoral condyle, much less frequently over the tibial insertion. On attempting to abduct the leg with the knee in extension, there is pain at the site of the lesion, with or without lateral mobility, according as the tear is complete or not. In chronic cases there is more or less lateral mobility, with a sense of insecurity and recurrent slight strains with mild effusions. When the short deep fibres have been torn, adhesions may form causing localized pain with limitation of rotation, in addition to the above-mentioned subjective symptoms.

Injury to the external lateral ligament is produced by an outward force applied to the extended knee. It is not so common as injury to the internal ligament. There are localized pain and tenderness, with laxity or pain when the ligament is stretched.

Loose Bodies.

A loose body causes a picture slightly similar to that due to a cartilage lesion; but the locking is not so distinct and is only momentary, and there is no distinct unlocking. The effusion is mild, and there are no localizing signs. The recurrences vary as to the localization of the pain, but a body anchored by a short pedicle may reproduce exactly uniform recurring attacks. Loose bodies may arise from fragments of the joint surface that have been fractured, from intraarticular cartilages or osteophytic outgrowths, or develop from the synovial membrane. Many loose bodies show up in radiograms, as they have a small bony element in them. When they give definite trouble, removal is indicated, as they gradually set up arthritic changes.

The condition known as *osteo-chondritis dissecans* is of special interest. It usually follows an injury in which the head of the tibia has been forced inwards on the femur so that the spine of the tibia has injured the articular surface of the internal femoral condyle on its outer side. The small piece of injured cartilage separates slowly with or without a thin layer of bone. During this period the joint is subject to mild recurrent attacks of effusion with weakness and discomfort. Sooner or later the fragment flakes off and acts as a loose body. X ray examination may reveal a small flake of bone loose in the joint, and the area from which it has arisen, if separation has occurred. Even before separation takes place outline of the damaged area may be observed in a good radiogram. The prognosis is good after removal of the fragment.

A fall on the flexed knee against an object, such as a stone, may flake off a small piece of the articular cartilage from the articular surface of the condyle. This may cause a mild sensitiveness of the knee, with perhaps slight effusion, which persists for months. A contusion of the bones near the articular margin, producing sensitiveness of the periosteum, will often cause a knee to be painful for weeks. The condition can be diagnosed by careful examination; the use of the limb may be encouraged without fear of further consequences.

Other conditions which cause internal derangements of the joint, or may be mistaken for it, are slipping patella, extraarticular exostosis interfering with tendon action, cysts of the cartilage (usually the external), periarticular ganglion, affections of the end of either tibia or femur (such as Brodie's abscess, giant-celled tumour, and affections of the various bursæ that surround the knee joint).

Affections of the Intrapatellar Pads of Fat.

The infrapatellar pads of fat overhang the anterior ends of the menisci. There is a distinct sulcus between each pad and the adjacent cartilage. After minor injuries adhesions occur in this sulcus, causing the knee to ache after use and mild local tenderness. More frequently the synovial fringe on the edge of the fat pad becomes enlarged from injury or inflammatory changes. The fringe then gets nipped repeatedly. The patient complains of mild aching under the patella, with some stiffness after exercise. The knee tires easily and occasionally lets him down. Locally there may be some definite enlargement, with slight tenderness and creaking on movement. In early cases the patient may be treated by means of a high shoe-heel to discourage full extension. The patient whose disability is of longer standing requires a knee cage with a stop at 25 degrees short of full extension. Operation to excise the fringes is required in cases resistant to conservative treatment.

The Treatment of Simple Synovitis.

The treatment of simple synovitis consists of rest to the ligamentous structures in the position of greatest relaxation during healing, pressure to hasten resorption of the effusion, and early systematic exercise for the quadriceps muscles. For preference, the knee should be strapped very tightly with adhesive plaster, or bandaged by means of wool pressure bandages firmly applied, and a light straight gutter back splint should be fitted, reaching from the upper part of the thigh to the lower third of the leg. With this the patient, as soon as the acute discomfort has gone, gets about. This ambulatory treatment is essential to permit exercise of the quadriceps. In addition, as the effusion is absorbed, quadriceps exercises should be increased, special attention being given to the *vastus internus*. When the patient fails in his efforts to contract the muscles voluntarily, graduated contraction by the Bristow coil is given until good voluntary contraction is reestablished. Massage is unnecessary, and is apt to distract the attention of the patient, the masseuse and the medical attendant, from the essential exercises.

Muscles can regain their function only by repeated voluntary contractions, and that may well be printed large on the walls of all physio-therapy departments. So soon as the effusion has subsided to the stage in which there is only slight puffiness of the joint, the splint and pressure bandages are removed, and light elastic pressure with a crêpe bandage applied. Walking, in conjunction with non-weight-bearing exercises, should be gradually increased as long as there is no return of the effusion. As function is regained, heavier weight-bearing work is allowed.

What if effusion returns? This is where mistakes are frequently made. Don't stop the walking, but lessen it for a day or so, when the effusion will subside, and exercises can be increased once more, but more slowly than before. If effusion keeps recurring, then the diagnosis must be reconsidered, for it is probable that some serious lesion has been overlooked.

The above treatment has been given in detail as it is essential in all cases of internal derangement. Failure to carry out treatment on such lines is responsible for the condition of quadriceps insufficiency that is all too commonly seen, and which seems to be imperfectly understood. The treatment of traumatic synovitis by rest in bed with the leg over a pillow for comfort, and various local applications such as iodine, antiphlogistine, hot foments *et cetera*, should be a memory of the past, but is, in my experience, still commonly used.

Quadriceps insufficiency follows any case in which the joint has been given an overdose of rest. The following is the usual history.

After a traumatic synovitis, as soon as the attempts are made to use the joint again, effusion recurs. More rest is given, but, when exercise is resumed, fluid reappears. This sequence may

be repeated several times with increasing flabbiness of the capsule and wasting of the muscles. What is the explanation? After an effusion of two or three weeks' duration the capsule becomes loose and flabby by stretching, and the *vastus internus* wasted and toneless from reflex stimuli *plus* disuse and stretching. This muscle normally braces up the capsule and holds the patella firmly against the femur. When an attempt is made to walk with the joint in such a condition, there is a definite sensation of insecurity and the patella seems to "float" away from the femur. The laxity of the capsule exaggerates the apparent amount of effusion. The patient loses confidence, will not use the limb normally, and so a vicious circle is established. If he is given gradually increasing walking exercises, with mild non-weight-bearing exercises and light elastic support, the effusion will disappear as the quadriceps muscles gain strength. Heat in the joint is commonly noticed at this stage, and particularly so if the exercise is increased too rapidly.

Here is a typical case.

E., a male aged 50 years, had twisted his knee five months previously, effusion ensued a few days later, and took three weeks to clear up. Since then he had complained of weakness with recurrent effusion into the joint. A recent effusion had been very severe. Nothing abnormal was detected except wasting of the *vastus internus* muscle, and a protective limp. He was treated by means of graduated contraction with a Bristow coil and graduated quadriceps exercises, and was taught to walk without a limp. After three weeks' treatment he had no further trouble.

Another case that is also instructive is the following.

Eleven weeks previously C., a male aged 36 years, had suffered from an effusion into the knee, with a little aching after use. He could not remember an injury. His doctor, who saw him one week after the onset, thought that there was tenderness over the cartilage. Since then he had been at rest, with the limb on a back splint; he had made several attempts to resume walking, but always with a recurrence of effusion. The X ray report ten weeks after the onset was: "Some low grade infection in both bones" (it was really the mottling from the marked decalcification of disuse). He was to be further immobilized because of this report. The knee was quite cold; there was no effusion; full movement could be obtained, except for a few degrees of flexion. The thigh muscles were very wasted, and there were no tender spots. Treatment as in the previous case restored him as fit to resume his work, supervising in a vineyard, in six weeks, although the joint became definitely warm and contained some effusion on several occasions, as he was inclined to be over enthusiastic in his exercises.

I would particularly draw your attention to the necessity of teaching these patients to walk naturally as soon as possible. No man walking with a limp favouring the knee, can get tone into his quadriceps muscles. Walking with slightly flexed knee is of little use to the quadriceps, as it is only acting as a fixator muscle instead of a prime mover, and the *vastus internus* hardly comes into action at all.

The Treatment of Recent Injury to Cartilages.

A recent injury to the cartilage should be treated as follows:

(1) Reduce the dislocation by manipulation (if necessary), with or without an anæsthetic. Full extension should be possible if reduction is successful.

(2) The limb should be rested on a back splint for three weeks while treatment as for simple synovitis is carried out.

(3) No lateral strains or twists should be risked for some weeks. The inner side of the heel is raised to cause "intoeing", and to throw the weight on to the outer side of the joint. If there is a recurrence of the attack, operation should be advised as the only treatment that will insure a sound knee. If operation is declined, then warning should be given against all rotational strains, a crooked heel provided, and all means taken to insure the greatest possible efficiency of the quadriceps muscles.

Operation.

Removal of the whole cartilage is advisable at operation. The posterior half that is commonly left behind may be the site of the lesion, and, if not, may have been loosened when the anterior part was damaged, and is a source of possible further trouble.

The operation can be adequately performed through a small incision. Exploratory operation is rarely necessary, but when it is indicated, the parapatellar incision is the best, although I should much prefer two small lateral incisions if it were necessary to explore each side of the joint. The psychological, apart from the physical, effect of a six-inch incision over the patella is not conducive to the early resumption of activity that is necessary. The patella-splitting incision is inadvisable, as it produces arthritic changes on the posterior surface of the patella.

Needless to say the greatest care should be taken to insure an aseptic technique. I always insist on a preparation of the skin over a period of thirty-six hours; I apply a tourniquet, and employ a "non-touch" technique that insures that only instruments enter the joint.

After-Treatment.

If satisfactory results are to be achieved by operation, the after-treatment is important. Firm wool pressure is immediately applied to the joint, to control hæmorrhage and the ensuing effusion. The limb is fixed on a gutter back splint, and three or four days later quadriceps exercises are commenced; they are increased each day thereafter. Walking is encouraged at the tenth day, the splint being retained for three weeks. By this time the patient should be walking quite comfortably, and the effusion should have disappeared. A woven elastic bandage then replaces the wool and splint, and non-weight-bearing exercises are given in addition to walking. These are steadily increased until the patient can walk three or four miles, when he is fit to resume active work, although heavy weight-bearing exercises are required to build up the quadriceps muscles for heavy work. In cases of long standing with marked wasting of the muscles, it will take months to restore their power even with heavy use. This point should be emphasized to the patient before operation, to prevent disappointments.

There is still an almost universal belief amongst laymen that this operation means a serious risk of a stiff knee. Why, it is difficult to understand. There also seems some fear of the operation on the part of many practitioners. The prognosis should be good. The operation is essential to anyone wishing to lead an active life. Manual labourers and athletes can be reassured as to their future. There is, I think, a tendency to assume that a cartilage injury means the end of an athletic career. In England a striking percentage of professional footballers have been operated on; many of them have had more than one cartilage excised. Ollerenshaw, in a recent address, stated that one of the Manchester teams was playing

a half-back line, from each member of which he had removed a cartilage. To the questions: "What is the use of the semilunar cartilages?" and "What takes the place of the cartilage?" I will only quote Sir Robert Jones.

Whatever the conclusion to which we arrive, there is no doubt that men can perform the most arduous and expert acts with these joints after removal of the cartilages, and without ill effects. I removed the semilunar cartilages in no less than six members of the same international football team. In one case, in which both cartilages were removed, he played through the season without a breakdown. In cases that have come to me with the history of the removal of a cartilage, I have found no trace of any new structure even ten years after the operation. Further, I have examined cases years after both cartilages have been removed, and have found no relaxation of ligaments.

What if the cartilage is not operated upon? With a major lesion that causes frequent locking, arthritic changes will certainly occur, and the patient will have an aching knee in middle age, which operative procedures will be too late to remedy.

Treatment of Strain of the Internal Lateral Ligament.

Treatment of a recent strain of the internal lateral ligament consists in the application of an external splint so as to prevent the slightest abduction of the leg. A wool pressure pad is applied over the ligament. At the end of a week walking is allowed, with the heel of the shoe raised on the medial side. If the ligament is severely torn, recumbency should be insisted on for three weeks. Quadriceps gymnastics should commence after the first few days. Failure to treat these cases seriously in the early stages will result in a permanently weakened knee that cannot be entirely remedied.

Synovial Adhesions.

Synovial adhesions frequently occur after injuries. They are particularly apt to occur when rest has been too prolonged. Arthritis, however, is the most common cause. Adhesions should be suspected when there is a recurrent slight effusion with discomfort or pain after use and limitation of movement with localized pain at the limit of motion. Common sites are the internal lateral ligament and the infrapatellar fat pad. The following cases illustrate the serious disability caused by light adhesions, and the results obtainable by manipulation.

P., a male aged 45 years, had suffered from an arthritic condition of the knee at the war sixteen years before I saw him. A flexion deformity had existed for nearly twelve months. He had always had some pain and a limp from the time of his original trouble. This had become worse the previous three months. Pain was mostly on the inner side; the joint used to ache after use. There was slight effusion with thickened synovia and crepitus on movement. Extension was limited at ten degrees short of full, and flexion, at 20 degrees past the right angle. Flexion caused pain at the posterior and the inner side of the joint.

Manipulation was performed, full movements being obtained; fine adhesions were felt to give way. There was very little reaction; he walked about freely next day; and three days later was walking without any discomfort whatever. Extensor exercises and walking were increased daily. Three weeks later he had almost full movement without any pain, and he has had no trouble since.

E.F., a woman aged 64 years, complained of stiffness in the knees in the mornings, which improved with a little use, but was worse after much walking. She had suffered more or less since injury seven years previously, resulting from a fall on both knees. The knees had been badly bruised, and some effusion had followed. Examination revealed nothing abnormal in the knees except that, in the left, flexion was limited at 25 degrees, and in the right at 10 degrees short of full. Rotation was limited in both. Pain was produced in the left on the inner side of the fat pad by forced flexion and rotation. Under general anæsthesia both knees were fully flexed and rotated through their full range, and fine adhesions were felt to rupture. The next day she could step up on to a chair, and kneel down without any discomfort. She was free of discomfort three months later.

It is common for a previously unobserved osteo-arthritis to be stirred up by injury, with a resulting joint ache that persists for months. Radiology proves that degenerative changes have existed for years. In some such cases adhesions may be the cause of the greater part of the discomfort and pain. After the injury, the joint has usually been more or less rested for a long period. Limitation of movement in one direction, with pain on approaching that limit localized to one part of the joint, is an indication for manipulation. In such arthritic cases manipulation should be gentle, and not through the whole range of the joint movement unless this is obtained very easily. In many of them the toning up of the muscles alone will result in great improvement. Here is a case.

F.J., a labourer aged 70 years, had twisted his left knee nine months previously. It was thought to be a cartilage lesion. Since then he had complained of pain, particularly on turning, and on going up stairs or down. The knee sometimes gave way when he walked. There was slight wasting of the thigh, and puffiness of the joint. Grating was produced by flexion, which was limited at 30 degrees short of full, and produced pain just above the joint line in front of the internal lateral ligament. Rotation was also limited. By manipulation fine adhesions were felt to give way as flexion was increased and the tibia rotated. He improved immediately, his discomfort diminished greatly and the movements of the joint became freer.

In other of these arthritic cases there is frequently the additional disability produced by a flexion deformity. Attempts at forced extension cause pain in the fat pads, which may or may not be tender. There is adaptive shortening of the hamstrings. The following is an instance.

Four months previously, W., a woman aged 53 years, while getting up from a chair, had felt a sudden pain in front of the knee; this was followed by swelling within a few hours. She had no pain at the time of examination, except after using the limb. The knee could not be extended within 30 degrees of full extension; when this position was reached, she got pain at the back of the knee, and over the external fat pad, which was tender. The knee was gradually straightened to within a few degrees of full extension, by means of a back splint, and then graduated contraction and walking were ordered for the care of the quadriceps muscles. Two months later she walked normally with no discomfort.

The importance of preventing flexion deformity cannot be too strongly stressed. For patients suffering from old-standing rheumatoid arthritis, pathetically attempting to walk with bent knees, the first thing is to correct the flexion by splinting. Exercises are then instituted, the patient walking daily in back splints until there is sufficient power regained to manage without them. Later, if flexion is not fairly free, manipulation will increase it. By persistent effort on these lines many of these patients will get comparatively comfortable knees, with moderate function and mobility. Much of the pain is due to the fact that at every step they are straining the

ligamentous and capsular structures of the joint, because there is insufficient power in the muscles to control it; thus the strain is thrown on the sensitive ligaments. Good results can be obtained only by carefully coaxing increasing movement in the joints, as the muscle power increases. It is unreasonable and unintelligent treatment to traumatize these joints by extensive manipulations; first, because there is insufficient muscle power available to move or control the joints through the increased range, and secondly, because scarred ligamentous and capsular tissue must be stretched gradually, otherwise it tears. These patients need to be coaxed and encouraged to carry out the requisite exercises, which require great mental effort on their part. They are easily exhausted, afraid of suffering further pain, and if the treatment proves in any way painful, they will refuse to carry on.

The Thomas Caliper Splint.

While dealing with disabilities of the knee joint I would call your attention to the great value of the Thomas caliper knee splint in many of them. When immobilization in the extended position is required, the Thomas splint is the most efficient available, and will immobilize the joint if correctly fitted and applied. Plaster will not do this, unless it is applied from waist to ankle. The groin-to-ankle splint allows five to seven degrees of movement when well applied over stockinette by those experienced in its use. As commonly applied over varying layers of wool, 10 to 20 degrees of movement may be present. This is only another illustration of a limb supporting a splint, instead of the splint supporting the limb. This is useless for the treatment of a tuberculous knee. The plaster does not prevent weight from being transmitted through the joint. Cross straps behind the ankle and knee are necessary, and in front, one above and one below the knee. These firmly hold the knee in the splint. The caliper should be fitted with a boot; a shoe tends to pull off if the splint is the correct length. For continuous wear a cloth or felt boot is most comfortable. Fitted with such, a caliper can be worn for years (the changing of socks being carefully performed as required) so that no flexion strain is placed on the joint. This may be at intervals of one to six weeks, according to varying conditions. The caliper should be adjustable so that it can be kept in a position of full weight-bearing as the child grows. To insure this when fitting, the splint should be so long that the heel should be at least 12·5 millimetres (half an inch) from the bottom of the boot. The wearing of a caliper for years is efficient local treatment for children suffering from tuberculous disease of the knees. In the treatment of adults, however, when the diagnosis is definite, arthrodesis should be performed. Cure is secured only with a stiff joint, and this is efficiently obtained by such an operation with great saving in risk and time to the patient. The prognosis when conservative treatment is applied to adults, is not so good as when children are so treated. I disagree with Hibbs's teaching, that even in children permanent quiescence is rarely attained by conservative treatment. It is entirely against the experience in English clinics. It is significant that conservative treatment in America is mainly by plaster splints, and the principles of Thomas that rest should be "enforced, uninterrupted and prolonged" are not followed with sufficient care for details. The caliper should be applied in all conditions of the knee when there is a marked tendency to flexion deformity, and as a convalescent splint after deformity has been corrected. This applies to septic arthritis of the knee joint, when useful mobility is unlikely to be reestablished. The splint should be worn for twelve months to insure a firm ankylosis of the knee, and to prevent the flexion deformity that will almost certainly occur if the limb is used unsupported. Any movement of less than 40 degrees of flexion is really a disadvantage. The knee is less stable, and always subject to slight strains with pain. It will certainly become a chronic painful joint and osteo-arthritis will develop in later life.

In infantile paralysis the caliper has proved invaluable when the time comes for ambulatory treatment, and the child has weak or paralysed quadriceps muscles. It protects the weakened extensors from over use, and controls the tendency to deformities such as knock-knee, and *genu recurvatum*. It need not be weight-relieving. I would protest against the use of expensive jointed splints for these children. They are ruinously expensive both in the first cost and in upkeep, and fail generally to do the work required of them. The use of a strong caliper allows a child to join in active games with other children, and so enjoy life.

When permanent splint control of the knee is required in adult life, money can be well spent on a more elegant caliper, with bucket top and a lock joint. It is inadvisable to fix the knee by operative means in such cases. There is almost always some defective control of the hip or foot. A stiff knee, with weak control of the hip, is not as useful and convenient as one controlled by a caliper with a lock joint.

In conclusion, let me say, the diagnosis of internal derangements of the knee joint is admittedly difficult. But if a careful history is taken, and examination is systematically carried out, the number of undiagnosed cases will be greatly diminished. Further, by the judicious use of rest to injured ligaments with systematic exercises for the thigh muscles, the periods of invalidity will be greatly lessened.

CARBON DIOXIDE: SOME OBSERVATIONS ON ITS USE AND ABUSE DURING ANÆSTHESIA.

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FOR the last two years, carbon dioxide has played an important part in my anæsthetic work. Shortly after commencing its use, I observed many beneficial results; but further experience has shown that there are limitations to its usefulness, and that in certain circumstances it may do actual harm.

Carbon dioxide is a waste product of the metabolism of living tissue. By virtue of its presence in

the normal blood stream, and its action on the respiratory centre, it is the main agent controlling the mechanism of respiration. Ordinary atmospheric air contains: Oxygen, 20·96%; nitrogen, 79·00%; carbon dioxide, 0·04%. Expired air contains: Oxygen, 16·40%; nitrogen, 79·50%; carbon dioxide, 4·10%. The average carbon dioxide content of alveolar air is in the region of 5%.

Lowering of the carbon dioxide content of the alveolar air causes a lowering of its tension in the blood, with the result that there is a diminution in frequency and depth of the respiratory movements with diminished lung ventilation. By this means, carbon dioxide accumulates until the normal tension is reestablished.

Increase of the carbon dioxide content of the alveolar air causes an increase in its tension in the blood and stimulation of the respiratory centre, with the result that there is an increase in the depth of the respiratory movements, with possibly a slowing or sometimes an increase in frequency. Lung ventilation, however, is markedly increased. In this way, excess of carbon dioxide is washed out until the normal tension is restored.

The following table taken from Starling: "Principles of Human Physiology", shows the effect produced by the addition of carbon dioxide to inspired air:

Percentage of Carbon Dioxide in Inspired Air.	Average Depth of Respiration.	Average Frequency of Respiration.	Ventilation of Alveoli with Inspired air. Normal, 100.	Alveolar Carbon Dioxide. Percentage.
0·04	673	14	100 (6·6 litres per min.).	5·6
0·79	739	14	116	5·5
2·02	864	15	153	5·6
3·07	1,216	15	226	5·5
5·14	1,771	19	498	6·2
6·02	2,104	27	857	6·6

The response to increased tension of carbon dioxide in the blood differs from that of oxygen starvation. In the latter, there is an increase in rate but the depth is lessened, later becoming jerky and intermittent. In the absence of oxygen, the respiratory centre quickly succumbs, there being a few gasps and then cessation of respiratory effort.

In anæsthesia, full oxygenation is a necessity. Should signs of oxygen starvation or deficiency appear, the cause must be rectified; if mechanical, by relieving the obstruction; if non-mechanical, by giving additional oxygen.

With mechanical obstruction to respiration, there will quickly develop a condition of excess carbon dioxide with deficient oxygen. Here the indication is for oxygen which will ordinarily be available in sufficient quantity from the atmosphere immediately the obstruction is freed.

No benefit will be obtained from the use of carbon dioxide in the presence of an oxygen deficiency, the cause of which is not first rectified.

Animal experimentation with increasing percentages of carbon dioxide in oxygen has shown that carbon dioxide is itself an anæsthetic agent. With the following percentages, these results were observed by Professor Leake and Dr. Waters in the Department of Pharmacology, University of California Medical School:

5%. Marked stimulation of respiration; rate increased, lung ventilation increased, blood pressure increased.
10%. More marked respiratory stimulation, rate increased; pulse increased; blood pressure increased.
10% to 20%. Great rise in blood pressure and pulse rate.
20% to 30%. Same; but clonic convulsions are apt to occur. They may be checked by increasing the oxygen or the carbon dioxide to 40%.
30% to 40%. The anæsthetic zone. The effects on blood pressure and pulse rate are much less marked.
40% upwards. There is increasing depression of respiratory and circulatory functions.
80%. Anoxemia begins to be a marked feature.
100%. After a short period of asphyxial symptoms, with rapid rise of blood pressure, slowing of pulse and stimulation of respiration, there is a sudden fall of blood pressure and stoppage of respiration and circulation at about the same time.

A mixture of carbon dioxide 30% and oxygen 70%, administered to man, has a sharply sour, acid taste, and produces a distressing feeling of shortness of breath. If administered for a short period of time, there is a rapid elevation of blood pressure, with a tendency to muscular twitching. It has not been administered for a sufficient period of time to discover whether the blood pressure, pulse and respiration will settle down with its continuance. Carbon dioxide, therefore, is a powerful agent. In conjunction with anæsthesia, it has its uses and abuses.

Practical Applications.

The practical applications of carbon dioxide will now be considered.

As an Adjuvant in the Induction of Anæsthesia.

Ether.

In inducing anæsthesia with ether, extreme care and deliberation must be exercised in accustoming the patient to the pungency and irritation produced by the vapour on contact with the respiratory mucous membrane. Carbon dioxide is here a help.

By allowing a small trickle to escape under the mask, respiration is deepened and lung ventilation increased. Tolerance to the vapour is established more quickly and the time of induction is shortened and the amount of ether required to complete the induction stage is less. The tendency to cough and strain is minimized and the patient, whilst losing consciousness, is protected from distressing sensations.

The actual amount of carbon dioxide used is not measured in any way. By noting the effect on the patient, one learns to regulate the amount so as to cause the patient no unpleasant sensations. A sufficiency produces full, deep respiration. It is quite unnecessary to cause an increase in rate.

I have noticed that too high a percentage of carbon dioxide in any stage of an anæsthesia cause an excessive secretion of saliva and mucous in the mouth and so, in all probability, elsewhere; for example, in the stomach, with increased probability

of post-operative vomiting. Hence one should avoid excessive mixtures.

Ethyl Chloride-Ether Sequence.

Ethyl chloride, properly administered, is a most delightful means of commencing an induction of anæsthesia. This has been my own experience on three occasions when I have been the victim. Sudden presentation of a strong vapour of ethyl chloride is probably very little less unpleasant than a sudden blast of ether.

It is my practice to commence induction with ethyl chloride in single drops at one to two second intervals. After about ten to fifteen drops, a small trickle of carbon dioxide is admitted and the rate of dropping increased. This is continued until the patient is just unable to reply to a question quietly put to him. By this time, respiration is full, deep and regular.[1]

The change over to ether is then made and the strength of the vapour rapidly increased, so that the necessity for accustoming the patient to ether vapour is obviated.

On account of the slow addition of ethyl chloride in the early stages, a somewhat larger volume per patient may be used than in a shock induction; but the ease and pleasantness of the induction justify the sacrifice of a little rather expensive material; and at no time is a high percentage of ethyl chloride in use, nor is the patient saturated with the vapour.

As with ether, the time of induction is shortened and less ether is required to produce the depth of anæsthesia desired. As the maintenance stage is reached, the carbon dioxide is shut off.

Chloroform.

I have not used carbon dioxide in conjunction with chloroform for induction, being guided by the great respect one has for chloroform and the feeling that any attempt at hastening a chloroform induction unduly is inviting trouble.

Ethylene and Oxygen. Nitrous Oxide.

Of all the types of case in which the choice of anæsthetic calls for ethylene, that of the shocked and very sick is the most important. One frequently finds that the lung ventilation is very limited, so much so that induction is a lengthy performance by reason of the inability of the patient to absorb sufficient ethylene.

The addition of a small percentage of carbon dioxide (5% to 10%) to the mixture of gases is rapidly beneficial. Respiration is deepened, blood pressure raised and the induction proceeds much more rapidly.

During the Stage of Maintenance: Use and Abuse.

Ether.

When the stage of maintenance is reached, the supply of carbon dioxide is shut off, unless and until there is an indication for it as shown by depression of the respiration or a weakening of the pulse. Should either or both of these conditions occur, the addition of a small amount of carbon dioxide is a remarkably rapid and efficient restorative. (See Case I.)

One does not attempt to maintain the patient at a constant depth of anæsthesia. Certain portions of a surgical procedure require a deep anæsthesia, and others permit of a very light anæsthesia.

If, during the course of an operation, one anticipates that the surgeon will be shortly carrying out some manœuvre which requires a deepening of the anæsthesia, this state is quickly brought about by the addition of a little carbon dioxide *plus* an increased supply of ether. When the manœuvre is completed, a little carbon dioxide and withdrawal of ether rapidly lighten the anæsthesia.

Chloroform.

If, during the maintenance of anæsthesia with chloroform, it is desired to lighten the anæsthesia for any reason (the anæsthesia may be too deep, the manipulation may allow a lighter plane of anæsthesia or there may have appeared some circulatory or respiratory depression) removal of the mask with the addition of a little carbon dioxide will rapidly lighten the anæsthesia.

Carbogen 5% (carbon dioxide 5% and oxygen 95%) is a very satisfactory agent for maintaining a chloroform anæsthesia when the Junker apparatus is being used. This particularly applies to those comparatively "poor risk" elderly patients undergoing bronchoscopic or laryngeal examination or operation, possibly with diathermy, for whom ether is contraindicated *inter alia* on account of fire risk; and the gaseous anæsthetics by reason of inaccessibility with of course the explosive risk of ethylene.

Ethylene and Oxygen. Nitrous Oxide.

Should occasion arise for stimulation during a gaseous anæsthesia, carbon dioxide may be added to the mixture, or may be allowed accumulate in the rebreathing bag.

It is in connexion with the gaseous anæsthetics that the carbon dioxide problem is ever present and abuse is likely to occur. With an anæsthetic administered on an open mask, excessive accumulation of carbon dioxide is rarely met; in fact, carbon dioxide depletion is more likely.

With a gas anæsthetic, the patient's respiratory system, the mask, connecting tubes and bag from a closed system. Of the products of respiration, some 4% to 5% are carbon dioxide, and this rapidly increases in the closed system.

For example, with a bag capacity of 10 litres, a tidal respiration of 500 cubic centimetres and a respiration rate of 20 per minute, the bag contents will be oxygen, 20%; ethylene, 80%; and carbon dioxide, 0%.

At the end of one minute, the percentage of carbon dioxide in the bag will be close to 5%, and the oxygen reduced to about 15%. By the end of the second minute, these percentages will be in the region of 10% carbon dioxide, 10% oxygen.

Now the normal alveolar air content of carbon dioxide is about 5% with an atmosphere containing 0·04%. (The alveolar carbon dioxide is somewhat

[1] This is not the deep stertorous breathing of a patient soaked with ethyl chloride, with widely dilated, fixed pupils, and near the extremity of tolerance. Production of this stage with ethyl chloride is unnecessary and so unjustifiable.

raised after preliminary sedation with morphine, the barbiturates *et cetera*.) Any increase of this percentage in the inspired atmosphere produces stimulation of the respiratory centre; and prolonged stimulation of any centre produces fatigue of the centre. So that, unless there is any definite indication for stimulation, the presence of more than 5% carbon dioxide in the bag system must put the patient to some unnecessary fatigue. (See Case II.)

To overcome this accumulation of carbon dioxide, it has been my practice, up to date, to empty the bag completely and to refill the bag with fresh gas mixture at two to three minute intervals, unless one wishes a temporary increase, in which case, additional oxygen must be added to recoup the oxygen percentage. This procedure necessitates the waste of much ethylene. The solution of the problem consists in fitting a soda-lime carbon dioxide absorption apparatus, by means of which the carbon dioxide content of the bag may be kept at a reasonable level, and provision made for the continuous addition of oxygen to keep up its percentage.

In this way, the same supply of ethylene will be used over and over again, additions being made from time to time as may be necessary, the closed circle technique being used. The amount of ethylene required to carry on a long anæsthesia will thus be considerably reduced.

At the Termination of Anæsthesia: Use and Abuse.

At the termination of an ether anæsthesia, the addition of a 5% to 10% mixture of carbon dioxide to air or oxygen aids the patient to excrete the ether accumulated in the tissues and so shortens the period of recovery. When it is used for this purpose, care should be exercised. Respiration should not be unduly stimulated, and when the administration is ending, the carbon dioxide should be gradually "tailed off", so that one does not leave the patient over-stimulated; for this is followed by a washing out of too much carbon dioxide from the system, with a compensatory stage of respiratory depression.

At the termination of an endotracheal or pharyngeal anæsthesia, the addition of carbon dioxide is not only useful but necessary. In both types of anæsthesia there is a continual washing out of carbon dioxide, so that at the termination the patient is saturated with anæsthetic and there is considerable respiratory depression due to carbon dioxide deficiency. The administration of carbon dioxide here helps in two ways: (i) By washing out the accumulated anæsthetic; (ii) by restoring the blood carbon dioxide to its normal level.

I have experienced much less trouble with respiration at the termination of these types of anæsthesia since using carbon dioxide.

In the same way, carbon dioxide may be used with advantage after a chloroform anæsthesia.

At the termination of a gas anæsthetic, carbon dioxide, either added or allowed accumulate, aids in ridding the patient of the anæsthetic. Here again, care must be taken to leave the patient in as nearly normal respiratory state as possible by the gradual removal of the stimulation. More care is necessary in these causes because, all through the anæsthesia, we have been facing the carbon dioxide problem. (See Case II.)

Use During the Post-Operative Stage.

The onset of post-operative lung complications is considered to be largely due to infection occurring in some portion of the lung which has been rendered airless and collapsed. This atelectasis is followed by collection of secretion which forms a nidus for infection.

Restriction of the respiratory movements by the protective splinting of the diaphragm after cœliotomy, general bodily depression due to the condition necessitating surgical interference and the stasis induced by recumbency aid in the process.

Thorough lung ventilation at intervals dispels this atelectasis, allows air to enter the collapsed lung and permits the collection of secretion to be removed by the natural mechanism, consequently minimizing the likelihood of infection occurring. This adequate lung ventilation is readily achieved by the inhalation of carbon dioxide 5% to 10% in oxygen.

There should be in every surgical ward, as part of its regular equipment, some satisfactory apparatus for administration of this mixture.

Every post-operative patient should have short periods of treatment with this at increasing intervals, say, an inhalation of the mixture for five to ten minutes at intervals of two hours in the first twenty-four hours; at four hour intervals in the second twenty-four hours; at six hour intervals in the third twenty-four hours, and so on as long as may be deemed necessary or advisable.

Particularly should this apply to those patients who have undergone cœliotomy, those deeply drugged as with "Amytal" *et cetera*, and those whose condition necessitates undue restriction of bodily movement.

Illustrative Cases.

Case I comes to mind, for I feel certain that the operation could not have been completed had not carbon dioxide been available.

A male, aged sixty-five years, had an enlarged prostate with obstructive symptoms of long standing. The bladder had been drained for upwards of two weeks during which time his general condition had improved considerably. Blood pressure and pulse pressure were normal. Blood urea was under 40 milligrammes *per centum* and no undue trouble with the anæsthetic was anticipated. Morphine 0·01 gramme (one-sixth of a grain) and atropine 0·6 milligramme (one-hundredth of a grain) were given one hour before operation. The ethyl chloride-ether sequence was used. Induction and early maintenance were quite satisfactory. Half-way through the operation, respiration became slow and shallow and the pulse fell off considerably in volume, although not accelerated. By the use of small quantities of carbon dioxide at intervals, he was carried through in a "Cheyne-Stokes" fashion. He had an uneventful convalescence.

CASE II. A male, aged sixty years, had intestinal obstruction of insidious onset in the lower part of the bowel. Operation was performed on the third day of the illness, by which time there was considerable colonic distention and there had been a little vomiting. At the commencement of induction with ethylene and oxygen the pulse was rapid and of poor volume. Induction was slow and quiet and considerable improvement in his general condition was noted. Pulse rate fell and the volume improved and respiration deepened with a moderate amount of rebreathing. So he was allowed to rebreathe a good deal (more than is allowed now—this was early in my experience of ethylene).

Caecostomy was done with expedition and at the end of the operation his condition seemed very good. Oxygen was then administered, but with no rebreathing. After five minutes, respiration became weak and pulse fell off considerably. Preparations were made for intravenous saline infusion, the head of the table was lowered and stimulants were administered. Fifteen minutes after completion of the operation, oxygen was still being continued, and during the saline injection, respiration ceased, the heart stopped and the mouth filled with regurgitated fluid.

What part did the sudden removal of carbon dioxide stimulation play in this case? In spite of the patient's desperate condition, I think he might have been carried on further had I had the added experience of the part played by carbon dioxide in anæsthesia that I now have.

THE DETOXICATING PROPERTIES OF SODIUM THIOSULPHATE IN "AVERTIN" INTOXICATION: AN EXPERIMENTAL STUDY.

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Introduction.

OUR work on the excretion of intravenously injected sodium thiosulphate during uncomplicated and complicated pregnancy, and puerperium of the bitch[1] as well as of the human being[2] demonstrated frequently a decrease in the sodium thiosulphate excretion. Rational explanation of this phenomenon could not be given, but it was thought that some of the thiosulphate might be used in a process of detoxication, peculiar to some pregnancies. This theory stimulated our interest in the detoxicating properties of sodium thiosulphate, and attention was therefore directed to the possibilities of demonstrating these properties in a more standardized intoxication produced experimentally.

For this purpose lethal or very deep "Avertin" anæsthesia ("Avertin" intoxication) was selected, first on account of familiarity with the subject gained in a previous investigation,[3] and secondly on account of the possible practical bearing of any positive results which might be obtained.

Methods of Investigation.

Dogs were given what was considered to be about the minimal lethal dose of "Avertin". Sodium thiosulphate was given intravenously, subcutaneously or rectally before, with, or after the "Avertin" infusion. If the animal did not succumb to the experiment, the same amount or a smaller amount of "Avertin" was given again some time later without sodium thiosulphate.

"Avertin" liquid was administered rectally in dosages ranging from 0·5 to 1·3 cubic centimetres per kilogram body-weight. The same precautions were taken to retain every cubic centimetre of the injection as were described in a previous communication.[3] The catheter was washed out with about 5 to 10 cubic centimetres of water before being withdrawn. The anal orifice was then kept closed by hand and as soon as the animal fell asleep was closed with an intestinal clamp. In order to avoid the administration of a large amount of fluid, "Avertin" was sometimes given in a strength of over 3%. Under these conditions the drug does not go fully into solution and is partly administered as a watery suspension.

Sodium thiosulphate was given intravenously or subcutaneously in 25% or 40% solution. When it was given rectally a 10% to 30% solution was used, either as a vehicle for the "Avertin" or sometimes as an irrigation after the "Avertin" had been given.

Occasionally the urinary excretion of sodium thiosulphate during and after anæsthesia was determined by titration with iodine as detailed in a previous communication,[2] and in a few cases the phenolsulphonephthalein excretion during the same period was estimated.

Experimental Results.

"Avertin" Administration Combined with Intravenous and Subcutaneous Injection of Sodium Thiosulphate.

Twenty experiments which are detailed in Table I were performed on ten dogs. In previous work the minimum lethal dose of "Avertin" in the dog was found to be below 0·7 cubic centimetre per kilogram body-weight.

We therefore gave to the first animal in our series 0·71 cubic centimetre of "Avertin" per kilogram body-weight. Four minutes after administration the animal became anæsthetized and 20 cubic centimetres of a 25% solution of sodium thiosulphate were given subcutaneously distributed in several places. The course of the anæsthesia, in spite of the large dosage of anæsthetic given, was remarkably uneventful. Respiration was satisfactory, no cyanosis occurred, and the animal recovered after seventy minutes of complex relaxation. A fortnight later the same amount of "Avertin" was given to the same animal, but without any injection of sodium thiosulphate. In this experiment respiration soon became very slow and ceased altogether twenty-five minutes after injection.

In experiment number II the dose of "Avertin" was raised to 0·75 cubic centimetre per kilogram body-weight and sodium thiosulphate was given intravenously as soon as the animal became anæsthetized. The dog recovered from the anæsthesia one hundred and thirty minutes after induction. In a later control experiment on the same animal without sodium thiosulphate, no recovery took place and respiratory failure with subsequent heart failure occurred after three hundred and five minutes.

In the third experiment the dosage was raised further up to 0·78 cubic centimetre per kilogram body-weight, but the dosage of thiosulphate, given intravenously five minutes after induction, was reduced to 2·5 grammes. This dog also recovered completely after two hundred and fifty minutes' anæsthesia. Respiration was shallow immediately after induction and before the sodium thiosulphate was given, but the administration of the salt at once improved the breathing. Later on respiration became temporarily slow again and moderate cyanosis was present after the first hour of anæsthesia, but the animal finally recovered spontaneously. Two and a half weeks later, the same animal was given 0·68 cubic centimetre of "Avertin" without sodium thiosulphate. This dosage, though considerably smaller, was not tolerated, and thirty-five minutes after administration of the anæsthetic the animal died with the usual symptoms of "Avertin" poisoning.

In the following experiment (dog number IV) only 0·61 cubic centimetre of "Avertin", without sodium thiosulphate, was given. Recovery took place after ninety minutes. When combined with the intravenous administration of sodium thiosulphate the anæsthesia only lasted sixty-five minutes. A week later the same animal received 0·75 gramme of "Avertin" per kilogram body-weight combined with five grammes of sodium thiosulphate, which was given partly intravenously and partly subcutaneously. The anæsthesia laster two hundred and forty minutes. Without thiosulphate and with the same

dosage of "Avertin", given two days later, the anæsthesia lasted only sixty minutes.

A fortnight later, to the same dog (number IV), 0·83 cubic centimetre of "Avertin" combined with eight grammes of sodium thiosulphate was given, partly subcutaneously and partly intravenously. This large dose of the anæsthetic was well tolerated and recovery took place three and a half hours after injection of the "Avertin". A control experiment on the same animal with the same large dose of "Avertin", but without thiosulphate administration, furnished the expected result. Death occurred after fifteen minutes of anæsthesia.

The fifth experiment was complicated by a previous unilateral nephrectomy. "Avertin" 0·64 cubic centimetre was given, combined with an intravenous injection of 2·5 grammes of sodium thiosulphate. The anæsthesia was satisfactory from every point of view and lasted two hours. A fortnight later the same amount of "Avertin" was given without thiosulphate. This control experiment proved to be fatal after about eighty minutes' anæsthesia.

The next experiment (number VI) was undertaken with the object of seeing whether possibly the previous administration of a large amount of thiosulphate given somewhat in advance of the "Avertin", might improve the favourable influence of the detoxicating agent noted after simultaneous administration. Three hours before the "Avertin" was given, eight grammes of thiosulphate were administered, partly subcutaneously and partly intravenously. The animal was not able to tolerate a dosage of 0·8 gramme of "Avertin" after this preliminary treatment, and death occurred fifty minutes after anæsthesia began.

The three experiments, VII, VIII and IX, demonstrate the limitations of the possible protective properties of sodium thiosulphate in "Avertin" intoxication. Thiosulphate given in various quantities did not prevent a fatal issue after "Avertin" in dosages ranging from 0·81 up to 0·86 cubic centimetre. However, as shown in experiment VII, a dog could be saved from the lethal effects of a dosage of 0·77 cubic centimetre of "Avertin".

As reported in a previous communication, puppies are somewhat less resistant to "Avertin" than full-grown dogs, if body-weight is used as the sole criterion.[3]

In experiment X we succeeded in protecting a puppy six weeks old against an anticipated lethal effect of "Avertin" (0·7 cubic centimetre per kilogram body-weight) by the previous administration of two grammes of sodium thiosulphate, given subcutaneously. A control experiment performed on the same

TABLE I.

Number of Experiment.	Body-weight. Kgm.	"Avertin" given per Kgm. bodyweight. c.cm.	Thiosulphate given. Grm.	Route of Injection.	Duration of Anæsthesia. (Minutes).	Result.	Time when Thiosulphate given.
I	7·4	0·71	5·0	Subcutaneous.	70	Recovery.	After induction.
		0·71			25	Death.	
II	5·8	0·75	4·0	Intravenous.	130	Recovery.	After induction.
		0·75			305	Death.	
III	7·6	0·78	2·5	Intravenous.	240	Recovery.	After induction.
		0·68			35	Death.	
IV	6·6	0·61	2·5	Intravenous.	65	Recovery.	After induction.
		0·61			90	Recovery.	
		0·75	5·0	Intravenous and Subcutaneous.	245	Recovery.	After induction.
		0·75			60	Recovery.	
		0·83	8·0	Intravenous and Subcutaneous.	210	Recovery.	After induction.
		0·83			15	Death.	
V	7·1	0·64	2·5	Intravenous.	120	Recovery.	After induction.
		0·64			80	Death.	
VI	7·7	0·9	8·0	Intravenous and Subcutaneous.	50	Death.	3 hours before induction.
VII	5·8	0·77	2·5	Intravenous.	180	Recovery.	
		0·86	4·0	Intravenous.	5	Death.	As respiration ceases.
VIII	6·2	0·82	4·0	Intravenous.	8	Death.	15 minutes before induction.
IX	6·1	0·81	7·0	Intravenous and Subcutaneous.	20	Death.	After induction.
X	1·1	0·7	2·0	Subcutaneous.	95	Recovery.	After induction.
		0·7			30	Death.	

animal a week later resulted in death after thirty minutes of anæsthesia.

"Avertin" Administration Combined with Rectal Administration of Sodium Thiosulphate.

In Table II is represented a series of experiments in which the "Avertin" was dissolved and suspended in a solution of sodium thiosulphate. Before giving this mixture it was ascertained that *in vitro* at body temperature "Avertin" and sodium thiosulphate do not react with each other. A mixture of one cubic centimetre of "Avertin" (liquid) suspended in 10 cubic centimetres of a 10% solution of sodium thiosulphate was kept in the incubator for two hours at body temperature. This mixture was then tested and it was found that the thiosulphate content remained stationary. No sulphur was liberated and a solution of Congo Red did not turn blue when added to the mixture.

TABLE II.

Experiment Number.	Body-weight. Kgm.	"Avertin" given per kilogram body-c.cms.	Concentration Thiosulphate used as vehicle for "Avertin" Grammes *per centum*.	Duration of Anæsthesia Minutes.	Result.
XI	7·1	0·58	10	0	Recovery.
XII	6·0	0·68	10	120	Recovery.
XIII	6·9	0·72	10	10	Recovery.
XIV	6·0	0·9	10	180	Recovery.
XV	10·0	1·0	10	180	Death.
XVI	6·0	0·83	20	100 Not relaxed.	Recovery.
XVII	5·1	0·92	20	95	Recovery.
XVIII	5·8	1·0	30	0	Recovery.
XIX	3·5	1·3	30	0	Recovery.

In the first four experiments the "Avertin" was given with 150 cubic centimetres of a 10% solution of sodium thiosulphate as vehicle. In experiment XI, 0·58 cubic centimetre of "Avertin" per kilogram body-weight was thus given. Complete anæsthesia was not obtained. The dog became drowsy but not relaxed, but after twenty minutes of restlessness remained in an ataxic state for another half hour. A fortnight later a control experiment was performed on the same animal with the same amount of "Avertin" in aqueous solution. Twenty minutes after administration of the drug the animal became apnœic and deeply cyanotic, but it was possible to save its life by bowel lavage with warm hypertonic sodium thiosulphate solution. This form of resuscitation will be again mentioned at the end of this section.

In the next experiment 0·68 cubic centimetre of "Avertin" per kilogram body-weight was given to an emaciated dog convalescent after an operation. The result was a satisfactory anæsthesia of two hours' duration, but the period of recovery was prolonged.

In experiment XIII 0·70 cubic centimetre per kilogram body-weight was given and the result was similar to that obtained in experiment XI. The dog, a healthy well-fed male, showed restlessness and ataxic movements for over thirty minutes, then it lay down, the feet still moving. Actual anæsthesia with relaxation was observed about seventy minutes after the administration of the anæsthetic and lasted for about twenty minutes. The period of recovery again was prolonged. After alternating periods of restlessness and drowsiness the animal became normal again in about two and a half hours.

By raising the "Avertin" dosage up to 0·9 cubic centimetre per kilogram body-weight (experiment XIV), a satisfactory anæsthesia was obtained, lasting for about three hours. No cyanosis occurred, but again the period of recovery was prolonged. In order to settle the question, whether and to what extent the thiosulphate was absorbed, the thiosulphate excreted in the urine was determined. The urine was found to contain 6%, 8%, and 7% of the sodium thiosulphate injected in the three consecutive hours of anæsthesia. Of phenolsulphonephthalein, which was given at the same time intravenously, there was recovered 45%, 24%, and 7% respectively during the same periods.

After giving 1·0 cubic centimetre of "Avertin" per kilogram body-weight together with 10 grammes of sodium thiosulphate, death occurred after three hours of anæsthesia (experiment XV).

In the next two experiments the "Avertin" was given together with 150 cubic centimetres of a 20% solution of sodium thiosulphate. An infusion containing 0·83 cubic centimetre of "Avertin" per kilogram body-weight was followed by a period of excitement, which lasted for fifteen minutes. Then the animal became drowsy and motionless for about a hundred minutes, but complete relaxation was never obtained. The period of recovery lasted about two hours.

With a considerably larger dosage (0·92 cubic centimetre per kilogram) an anæsthesia of about an hour and a half duration could be obtained. The period of induction as well as the period of recovery was again prolonged.

As shown in the last two experiments, XVIII and XIX, no anæsthesia follows in reasonable time if the vehicle for the "Avertin" contains 30% or more of sodium thiosulphate. In the first experiment (XVIII) 1·0 cubic centimetre and in the second experiment (XIX) 1·3 cubic centimetres of "Avertin" per kilogram body-weight were given. Both animals were made to retain the mixture for twenty minutes, but only drowsiness resulted.

In these experiments where very large amounts of "Avertin" were given, no control experiments were performed, because the result undoubtedly would have been fatal.

As already pointed out in experiment XI (Table II) it was possible to revive an animal on the verge of respiratory failure by washing out the bowel with a warm hypertonic sodium thiosulphate solution. In other experiments of a similar nature it was found that repeated flushing out of the bowel with a warm 30% sodium thiosulphate solution acted as a restorative if the condition of the animal was not too far advanced. The following is a typical experiment.

A female dog received 0·93 cubic centimetre of "Avertin" per kilogram body-weight. At the completion of the injection the animal was unconscious. Ten minutes later it was deeply cyanosed, with only two respirations per minute. The bowe was then irrigated with 300 cubic centimetres of warm 30% sodium thiosulphate solution. Almost immediately after beginning the irrigation, the animal made a few deep inspirations and the cyanosis disappeared. Following this, respiration was maintained at a satisfactory rate, and the animal recovered from the anæsthesia forty-five minutes later.

In ten instances the possibility of resuscitation immediately after cardiac failure by means of bowel lavage with sodium thiosulphate and artificial respiration was examined. We succeeded only in three attempts. The following is a record of such a success:

A medium-sized dog was given 1·0 cubic centimetre of "Avertin" per kilogram body-weight. The animal was unconscious one minute after the infusion, and fifteen minutes later respiration had ceased. The heart stopped two minutes later. After waiting for thirty seconds the bowel was washed out with 100 cubic centimetres of a warm 30% thiosulphate solution and artificial respiration performed for three minutes. The heart started to beat again and the animal resumed breathing. The bowel was then washed out once more with 100 cubic centimetres of sodium thiosulphate solution of the same strength. After this the breathing became regular, the cyanosis disappeared and in twenty minutes the animal showed signs of recovery from the anæsthetic.

Increased Tolerance after previous "Avertin" Anæsthesia.

In experiment IV in Table I, where the control experiment was performed two days later, the anæsthetic lasted only a quarter of the time occupied by the original experiment, where sodium thiosulphate was given with an equal amount of the anæsthetic. That this most probably was due to an increased tolerance, developed by the previous administration of "Avertin", is shown by the following experiments:

A female fox terrier received 0·57 cubic centimetre of "Avertin" per kilogram body-weight. In three minutes anæsthesia followed, and respiration became very slow, with definite cyanosis. The clamp on the anus was therefore released and the fluid in the rectum allowed to escape. This brought no relief and after respiration had actually stopped for one minute the bowel was washed out with 200 cubic centimetres of warm 30% solution sodium thiosulphate. Respiration was immediately resumed, cyanosis disappeared, and within thirty-five minutes the animal showed the first signs of awakening.

A larger dosage of 0·62 gramme was given two days later to the same animal. This was readily tolerated and produced an uneventful anæsthesia lasting for sixty-five minutes.

After another two days 0·7 gramme per kilogram body-weight was given. This large dose was also well tolerated and the anæsthesia lasted seventy minutes. Two days later the animal was capable of tolerating 0·75 gramme per kilogram, and remained anæsthetized for sixty minutes. However, a week later the original dosage of 0·57 cubic centimetre was given again and the animal died in forty minutes. Within a week the increased tolerance due to previous "Avertin" administration had apparently disappeared.

Other less complete experiments showed the same results, namely, that a preceding "Avertin" administration establishes a tolerance for a lethal dose of "Avertin", if given within the succeeding four days.

The Excretion of Sodium Thiosulphate under the Influence of "Avertin" Anæsthesia.

That "Avertin" has no harmful post-anæsthetic effects on the kidneys, and that moderately severe renal insufficiency is no contraindication against "Avertin" anæsthesia, has been shown in a previous communication.[3] But as already shown by Bruger, Bourne and Dreyer,[4] temporary depression of renal function may occur during "Avertin" anæsthesia. We were able to confirm this observation by determining the hourly urinary volume. In deep "Avertin" anæsthesia complicated by cyanosis, almost complete anuria lasting from thirty to ninety minutes was observed.

Table III presents the results of a series of five experiments under different types of anæsthesia, where the sodium thiosulphate and the phenolsulphonephthalein excretion were studied after the intravenous injection of 2·5 grammes sodium thiosulphate and 6 milligrammes of phenolsulphonephthalein. Two experiments (G and H) are given as controls. In these instances no "Avertin" had been administered.

The purpose of these experiments is to examine the question whether sodium thiosulphate was retained during "Avertin" anæsthesia in preference to phenolsulphonephthalein.

Experiment A, with two hundred and seventy minutes of anæsthesia, demonstrates such a preference. In the first two hours of anæsthesia only 15% of sodium thiosulphate was excreted, as compared with 44% of phenolsulphonephthalein, but towards recovery the excretion of sodium thiosulphate increased while the phenolsulphonephthalein excretion remained almost stationary at a low figure.

The next two experiments demonstrate hardly any such difference. They are characterized by the fact that the excretory function in the first hour was practically at a standstill. It was felt that under such conditions a preferential retention of sodium thiosulphate could hardly be observed. These ex-

TABLE III.

Number.	Thiosulphate Excretion Percentage.					Phenolsulphonephthalein Excretion Percentage.					Duration of Anæsthesia. Minutes.	"Avertin" given. C.cm. per kgm. body weight.
	One Hour.	Two Hours.	Three Hours.	Four Hours.	Five Hours.	One Hour.	Two Hours.	Three Hours.	Four Hours.	Five Hours.		
A	11 (20 c.cm.)	4 (10 c.cm.)	11 (20 c.cm.)	25 (35 c.cm.)	30 (45 c.cm.)	36	8	3	3	7	270	0·75
B	Trace. (trace).	4 (15 c.cm.)	18 (32 c.cm.)	28 (72 c.cm.)		Trace.	3	12	24		240	0·78
C	Trace. (trace).	33 (80 c.cm.)	18 (40 c.cm.)			Trace.	38	24			120	0·64
D						60 (5 c.cm.)	5 (5 c.cm.)				90	0·58
E	54 (70 c.cm.)	4 (5 c.cm.)	1			60	4				60	0·61
F	52 (65 c.cm.)	5 (12 c.cm.)				60	6				60	0·62
G	67	7				58	8				0	0·00
H	66	10				57	5				0	0·00

periments, as well as the first, show an increased urinary output on approaching recovery.

Experiments E and F were of short duration (sixty minutes). The phenolsulphonephthalein output was within normal limits while the sodium thiosulphate excretion was slightly but distinctly subnormal as compared with that observed in the control experiments G and H.

Comparing these figures with those of Bruger, Bourne and Dreyer for urinary volumes under "Avertin" anæsthesia, it is quite evident that sodium thiosulphate exerts a strongly diuretic effect. This is also brought out in experiment D, where only phenolsulphonephthalein was given. In this case the urinary volume was small compared with that obtained in the experiments where thiosulphate was given.

Discussion.

The Detoxicating Properties of Sodium Thiosulphate.

Detoxicating properties of sodium thiosulphate have been described against a large variety of chemical poisons, such as compounds of the heavy metals, carbon monoxide, hydrocyanic acid and its derivatives and other substances. The detoxication of hydrocyanic acid with sodium thiosulphate has probably been most extensively studied, and its beneficial action on the associated respiratory paralysis has been emphasized. This being the case, it was considered that a similar beneficial action might be hoped for in the presence of "Avertin" poisoning, where asphyxial symptoms are prominent.

It may be stated without going into details that no certain effective measures against "Avertin" overdosage are known. As our experiments show, the detoxicating properties of sodium thiosulphate, although easily demonstrable, are limited. Intravenous or subcutaneous injection of sodium thiosulphate increases the tolerance for "Avertin" by as much as 50% of the minimum lethal dose, but there is no stoichiometric relation between the amount of antidote and the increased tolerance for the toxin, and an increase of more than 50% in the tolerance could not be obtained by any further increase of the amount of sodium thiosulphate given. (Table I.) The small magnitude of this effect is well illustrated by the finding that a previous administration of "Avertin" may increase the tolerance to the same extent as the administration of sodium thiosulphate.

As a restorative in case of emergency, sodium thiosulphate given intravenously may be of some use if given early enough, but rectal lavage was found to be more effective and we would recommend a combination of the two measures.

In non-fatal narcosis the duration of the process of detoxication, as measured by the duration of the anæsthesia, is shortened, as demonstrated in experiment IV (Table I). No further attempt was made to study this aspect of detoxication. We directed our attention rather towards the question of protection against lethal doses, since it was felt that this method in the dog was more conclusive and less subject to individual variations. However, after completing our experiments we found that very recently Waelsch[5] demonstrated a shortening of the period of detoxication following sodium thiosulphate injections in "Avertin" anæsthesia in white mice. Our work also confirms his observations that the respiration visibly improves after the sodium thiosulphate administration.

Rectal Administration of Sodium Thiosulphate.

Sodium thiosulphate in about 30% solution administered by the rectum simultaneously with "Avertin" protects against more than a twice lethal dose of the drug, and not even anæsthesia may result. (Table II.) Less concentrated solutions of about 20% strength may protect dogs against death if as much as a twice lethal dose of "Avertin" has been given. Anæsthesia of over three hours duration may occur, but the absence of any marked degree of cyanosis is a feature of these experiments. Even with a 10% solution of sodium thiosulphate administered together with the anæsthetic, detoxicating effects are noticeable. In this case they are, roughly speaking, of about the same magnitude as when the thiosulphate is given intravenously.

In those experiments where anæsthesia results, the period of induction as well as the period of recovery is prolonged. This is in all probability due to delayed absorption of the "Avertin" in the presence of the hypertonic solution of sodium thiosulphate. The markedly prolonged period of recovery may be explained by the hypothesis that some of the "Avertin" may combine with the sodium thiosulphate to form a less anæsthetic combination, which over a period of several hours slowly releases "Avertin" in a concentration sufficient to produce drowsiness. The fact that with a very high concentration of sodium thiosulphate (30% or over) it is impossible to induce anæsthesia may be explained by the assumption that the absorption of "Avertin" is so much delayed and diminished that a sufficiently high concentration of the anæsthetic cannot be reached. Only analgesia may be obtained. This observation of a delayed and diminished absorption of "Avertin" in the presence of sodium thiosulphate most probably only represents a special case of a general law, that when two crystalloids are administered rectally each may influence the absorption of the other in proportion to their respective amounts present.

This group of experiments seems to demonstrate that theoretically at least "Avertin" anæsthesia may be controlled to a certain extent by adding varying amounts of sodium thiosulphate to the "Avertin" solution. Possibly other salts may act in the same way. Practically, this may be of use in obstetrics, where prolonged analgesia is desired. In this field the addition of milk to the "Avertin" solution has already been recommended.

Over 20% of the rectally injected sodium thiosulphate was recovered in the urine during the period of anæsthesia after the administration of an "Avertin" sodium thiosulphate mixture, which contained 100 cubic centimetres of a 10% solution of sodium thiosulphate. Consequently about as much thiosulphate must be present in the circulation as in the experiments where the salt was administered intravenously, and in all probability an actual detoxicating influence is present as well as the factor of delayed absorption.

In these experiments the magnitude of the detoxicating factor is difficult to assess on account of the delayed absorption. However, judging from our observations, we are inclined to assume the presence of at least as effective a detoxication as is present after intravenous or subcutaneous sodium thiosulphate administration. As already mentioned, prolonged anæsthesia was found to be remarkably free from cyanosis, a finding which we are inclined to attribute rather to detoxication than to delayed absorption.

The restorative effect observed on flushing out the bowel with warm hypertonic sodium thiosulphate solution cannot be entirely explained by mechanical removal of the "Avertin", as this measure was also found to be effective after anæsthesia had lasted for more than half an hour, by which time most of the "Avertin" had been absorbed. Judging from the sudden response in many instances to the bowel lavage, we conclude that the effect in the first instance represents a stimulus somewhat similar to that produced by the stretching of the anal orifice. Discussion of this form of stimulation does not fall within the scope of this paper, though it may be mentioned that saline solution has been recommended as a restorative. However, in our opinion the restorative effect of a strongly hypertonic sodium thiosulphate solution is somewhat more outspoken, and in some of the experiments it was astonishing how quickly a deeply cyanosed animal on the verge of respiratory failure recovered without other means of resuscitation, after which the subsequent speedy recovery from the anæsthesia could be partially attributed to a detoxicating action of the absorbed sodium thiosulphate.

The Excretion of Sodium Thiosulphate under the Influence of "Avertin" Anæsthesia.

The demonstration of a specifically increased thiosulphate retention during "Avertin" anæsthesia would strengthen the hypothesis of an actual detoxication by chemical combination with the toxin. In order to be in a position to make an assessment of the sodium thiosulphate retention in the light of renal function in general, we compared the thiosulphate excretion with that of phenolsulphonephthalein.

As shown in Table III, in uneventful "Avertin" anæsthesia of about one hour's duration, the phenolsulphonephthalein excretion is within normal limits; the sodium thiosulphate excretion is slightly but distinctly diminished, and the urinary volume is increased. During very deep prolonged "Avertin" anæsthesia, a condition which may rightly be called "Avertin" intoxication, the phenolsulphonephthalein as well as the sodium thiosulphate excretion may become almost nil, due to a very marked oliguria. (Table III.) However, this depression is transient and the beginning of a copious flow of urine indicates recovery earlier than physical signs. During this sodium thiosulphate diuresis the dye and the thiosulphate are secreted in large and about equal amounts. As compared with the findings in unanæsthetized animals the percentage of each excreted within any hourly period is subnormal. During prolonged "Avertin" anæsthesia, where oliguria is absent or not too severe, a preferential retention of sodium thiosulphate as compared with phenolsulphonephthalein could be demonstrated. (Experiment I.)

However, on account of the renal depression occurring in "Avertin" anæsthesia, these experiments are not convincing enough to prove beyond doubt the specific retention of sodium thiosulphate for the purpose of detoxication. No experiments have been performed to examine the question whether some of the "Avertin" was excreted, not as glucuronate, but in combination with some sulphur-containing compound. Without any direct proof it would be rational to assume that the detoxicating action of sodium thiosulphate is non-specific and is probably due to an increased formation of glutathione, "the hormone of cell respiration", stimulated by the excess sulphur introduced as thiosulphate. The detoxicating properties of glutathione are well recognized, and Waelsch and Weingerger[6] showed the glutathione content of the blood to be reduced during "Avertin" anæsthesia.

In referring to the idea which stimulated this research, it may be pointed out that the retention of sodium thiosulphate during "Avertin" anæsthesia is somewhat similar to that seen in certain pregnancies, where no renal dysfunction is observed, but where quantitatively a much more marked depression is observed than in "Avertin" anæsthesia without renal dysfunction. Furthermore, in the case of pregnancy the effect may be present for months, so that only a small amount of circumstantial evidence has been produced to show that the thiosulphate retention in certain pregnancies is due to a toxæmia.

Summary.

1. A detoxicating effect of sodium thiosulphate given intravenously or subcutaneously, has been demonstrated in "Avertin" intoxication. The effect is of small and uncertain magnitude.

2. An increased tolerance for "Avertin" of about the same magnitude could be demonstrated during the three days following an "Avertin" anæsthetic.

3. Simultaneous rectal administration of "Avertin" and hypertonic sodium thiosulphate delays the absorption of the "Avertin". With a 30% solution of sodium thiosulphate it may become almost impossible to induce "Avertin" anæsthesia in the dog.

4. In cases of overdosage high rectal irrigation with a warm hypertonic sodium thiosulphate solution acts as a restorative, if applied before cardiac failure occurs.

5. It could be demonstrated that in some experiments, sodium thiosulphate as compared with phenolsulphonephthalein is retained to a somewhat greater extent.

6. During "Avertin" anæsthesia, sodium thiosulphate is absorbed from the large intestine in appreciable amounts.

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DIABETIC COMA.[1]

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THE introduction of insulin into the treatment of *diabetes mellitus* has materially altered our outlook on diabetic coma. Prior to the isolation of insulin the occurrence of coma usually represented the terminal stage of a serious illness, while now it can be regarded in many cases as an incident in the course of the disease. Further, owing to the improvement in the general health of diabetic patients during the past decade, the incidence of coma has lessened and the mortality from this cause has markedly diminished. Because of our increased knowledge of the subject, anticipation and prevention of this condition are now possible in many instances. Nevertheless, coma must still be regarded as the most serious and the most urgent of the complications of *diabetes mellitus* and, when its presence is suspected, it demands constant observation and immediate treatment lest the condition progress and valuable time be lost.

Before commencing the consideration of the causation of coma, it is interesting to consider some clinical features which appear to indicate a predisposition to its development. In reviewing the histories of the patients with diabetic coma admitted to the Alfred Hospital within the past few years, it is found that most of them can be placed into one of three groups:

(i) Those who, from carelessness or from lack of proper education regarding their condition, neglected instructions with regard to diet, insulin or personal hygiene. This is a large group, and an important one, because, with proper care and education, these cases of coma should be preventible. The part played by neglect of diet and insulin in this regard has been pointed out by Joslin,(1) who states that 70% of his cases of coma have occurred from this cause.

(ii) Those in whom some infection occurred complicating the diabetic state. It is a well-known fact that most infections produce a marked disturbance of carbohydrate metabolism in normal individuals. This disturbance occurs in the diabetic also, and is often fraught with considerable danger. Abstention from food during the illness, together with the lessened efficacy of insulin during the infection, may lead to coma in a comparatively short space of time. This type, although not preventible by education of the patient, can be anticipated. By warning the diabetic of the dangers of even the mildest infection and by stressing the importance of early medical attention, it is possible to safeguard many patients.

(iii) Those in whom diabetes developed rapidly and was neglected until coma supervened, medical attention being then sought for the first time. These patients are usually found to be suffering from severe diabetes which has progressed from an almost explosive onset to coma within a few weeks.

Diabetic coma may occur in patients of almost any age. It tends to be more common in youth and early adult life, probably because diabetes is usually more severe then. Nevertheless, it may occur in advanced age, frequently accompanied by some complication, such as an infection or gangrene. It is unusual to find an uncomplicated coma in previously well nourished patients; they are usually wasted by the ravages of the uncontrolled disease. On the other hand, coma complicated by infection may occur in any type of diabetic.

Of the underlying factors which produce coma there is much which has yet to be learned. *Diabetes mellitus*, although probably a primary disturbance of carbohydrate metabolism, is associated with far-reaching effects on other metabolic processes. The metabolism of protein and of fat is affected to a greater or less extent in all instances. The state of coma attracts attention to the incomplete metabolism of fats in the blood stream by reason of the accumulation of their soluble products—a condition which we know as ketosis. This accumulation of fat metabolites has the effect of decreasing the alkaline reserve of the blood plasma, thus inducing an acidosis which resembles the condition seen at times in the late stages of chronic nephritis. It is well recognized that a certain amount of carbohydrate is necessary for the complete oxidation of fats, and it is probably the absence of this carbohydrate in a usable form which is responsible for the accumulation of these intermediate products of fat metabolism in the blood stream. The hyperglycæmia which is almost invariably found in comatose patients, cannot in itself produce coma, and is thought to represent an accumulation of carbohydrate which is useless, because the patient cannot produce sufficient insulin to render it available for the complete oxidation of fat.

Recently Dodds and Robertson(2) have critically examined the ketosis and the acidosis theories of diabetic coma and have thrown doubt upon them. By serial estimations of aceto-acetic and β-hydroxybutyric acids in the blood plasma and by determinations of its alkaline reserve in a series of comatose patients, they conclude that neither theory will explain the facts which they observed. They submit no other hypothesis and their work at present awaits confirmation.

In addition to the occurrence of ketosis and acidosis in diabetic coma, there is ample evidence of the impairment of other vital functions. The

[1] Read on August 21, 1931, during the annual post-graduate course, Melbourne Permanent Post-Graduate Committee.

heart is nearly always affected, together with the entire vaso-motor system, so that the patient often presents a picture closely resembling that resulting from surgical shock. The kidneys likewise show evidence of disturbances of function. Albuminuria, with or without the presence of casts, is frequently found. Renal failure, as shown by the development of oliguria or of anuria, is not uncommon, and curious anomalies of renal permeability may occur.

At this stage it is opportune to consider the results in those cases in which treatment was unsuccessful. There are three chief reasons for the failure of treatment to produce recovery from diabetic coma: (i) Circulatory failure, which is the cause of death in the vast majority of fatal cases; (ii) failure of response to insulin therapy because of the presence of infection or because of the impaired circulation; (iii) renal failure, which, as already, mentioned, may result in absolute anuria. In consequence, the treatment of an established case of coma must be directed not only to the relief of the condition of ketosis, but also to the prevention, as far as possible, of both circulatory and renal failure.

The onset of diabetic coma is usually gradual, its full development being a matter of some hours. The prodromal symptoms are numerous and may not all be found in any one patient. The commonest early symptoms are lack of energy, tiredness, anorexia, nausea, vomiting or retching, headache, vertigo. A little later nausea and vomiting become more marked; the tiredness increases to drowsiness, at first transient, but later becoming accentuated and deepening to actual coma. At this stage the patient may complain of severe pain, which may be located in any part of the abdomen or in the thorax. This may give rise to some difficulty in differential diagnosis. Examination of the urine will, however, give the clue to the underlying diabetic condition. The breathing at this stage may show some alteration; increased depth of respiration may be noted, later developing into the typical picture of air hunger.

The appearance of an established coma is well known. The patient lies unconscious, breathing deeply, the breath smelling of acetone; the skin is cold and clammy, the pulse is thin and rapid, the temperature subnormal, the blood pressure low, the ocular tension greatly decreased, the tongue glazed and dry, and the urine is found to be loaded with sugar, diacetic acid and acetone.

Diabetic coma is one of the most urgent conditions of medical practice and may well be compared with such a surgical crisis as the rupture of an abdominal viscus. Every hour lost before treatment is commenced materially prejudices the patient's chance of recovery.

At the outset it should be realized that the ketosis must be relieved as rapidly as possible. As there is always a danger of circulatory failure, the initial insulin dosage should be large. Fifty units administered subcutaneously are advisable as the first dose, and in severe cases this dose may be repeated several times at intervals of half an hour. In the absence of facilities for frequent blood sugar estimations, it is advisable to commence the administration of glucose or some other form of carbohydrate quite early in the treatment. Hyperglycæmia in itself will produce no serious ill effects and it is better to err in this direction than to run the risk of producing a hypoglycæmia. One and a half to two ounces of glucose in water alone, or flavoured with orange juice, should be given with each injection of insulin. Should glucose prove nauseating, cane sugar or some other form of carbohydrate may be used. Glucose may also be administered rectally in saline solution, but its value is problematical, since much doubt exists as to whether there is appreciable absorption of glucose through the rectal mucosa.

In the initial stages of treatment it is often necessary to empty the bowel by an enema, and if vomiting is a marked feature, a stomach wash-out is indicated.

The administration of alkalis is not advisable. Whatever their effect in other forms of acidosis, it has been shown that alkalis delay recovery from diabetic coma.

In the absence of blood sugar estimations, frequent examinations of the urine must be made—at intervals of from two to three hours—as they provide a valuable guide to the progress of treatment. It may be necessary to catheterize the patient's bladder to obtain the necessary samples of urine. Decrease in the amount of diacetic acid, as shown by the ferric chloride test, is the first evidence that the ketosis is being overcome, and later the urine will be found to contain none. Acetone will probably remain for some time and disappears much more slowly. An examination of the urine for sugar must be performed on every specimen and the absence of urinary sugar is a warning that the patient is in danger of hypoglycæmia.

The continuance of insulin therapy will depend upon the urinary findings and the general condition of the patient, more particularly in the decrease of air hunger and lessening of the depth of coma. It may be necessary to give some hundreds of units of insulin before much improvement is noticed. Intravenous administration of insulin is not such a satisfactory procedure as one would imagine. The effects are usually transient and of little benefit.

With regard to circulatory failure, the blood pressure and pulse rate form the most reliable guides to prognosis and should be estimated at half-hourly intervals. Warmth is essential, and as soon as treatment is commenced every effort to maintain the body temperature should be made, by blankets, hot water bottles and electric light cradling. The liberal administration of fluid is of great importance. If possible, fluid should be freely given by mouth, and, as mentioned before, the addition of glucose or some other form of carbohydrate is advisable.

In addition, normal saline solution may be given at intervals *per rectum*, subcutaneously or intra-

venously. If the patient is unable to retain glucose taken by mouth, the addition of 10% or 15% solution of glucose to saline solution administered intravenously is a useful method of supplying carbohydrate. The administration of hypertonic saline solution (1·2%) has been recently suggested by Lawrence[3] in extreme cases of dehydration. He advises that large quantities, up to five pints or even more, should be given slowly at the rate of half a pint in from twenty to thirty minutes. The addition of gum to the saline solution, or blood transfusion, if circumstances permit, is useful in combating circulatory failure.

Apart from warmth and fluids, stimulants such as black coffee and brandy should be given. Drugs such as "Coramine", camphor and strychnine also find a place in maintaining the general strength of the patient.

In the event of hypoglycæmia occurring during the progress of treatment, some difficulty may arise in its recognition. It is quite possible for a patient to pass from diabetic coma to hypoglycæmic coma without any intermediate phase of consciousness. If no facilities for blood sugar estimation are available, examination of the urine is the most reliable guide for the recognition of this condition.

The treatment of hypoglycæmia involves the liberal administration of carbohydrate by mouth or the intravenous administration of half to one ounce of glucose in saline solution. The value of pituitrin (half to one cubic centimetre) in this condition can be emphasized and, although less effective, adrenalin hydrochloride, one in 1,000, in doses of 0·3 to 0·6 mil (five to ten minims) is also used as an emergency measure.

Following the recovery from coma it is usually impossible to resume strict dietary control at once. For from twelve to twenty-four hours it is advisable to allow the patient to partake of easily assimilated carbohydrate and protein food, such as eggs, milk, Benger's food, arrowroot *et cetera*, and to allow fats to be taken sparingly. The insulin dosage at this stage will be determined by the urinary or blood sugar findings. Following this it is usually possible to start strict dietary control and to proceed to stabilization along ordinary lines.

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Reports of Cases.

FATAL SNAKE-BITE.

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FOLLOWING on the interesting articles on snake-bite now appearing in the journal, the following fatal case that I had in my practice in 1908 may be of interest.

A.J., aged ten, was bitten on the bare foot by a black snake, described as three feet long. The snake took a firm hold and had to be pulled off by a friend. Two ligatures were tied round the leg above the ankle, but they were so loosely applied as to be quite useless. He was brought to me one hour and twenty minutes later.

The child appeared perfectly well, but there were two punctures distinctly visible close to the base of the great toe. The wound was freely incised and wet cupped, and an "Antiphlogistine" poultice was applied. Strychnine was administered hypodermically and hot, strong coffee by the mouth. The child was admitted to hospital. Hot poultices were applied every two hours and the wound bled freely. The child was kept awake till midnight, seven hours after being bitten and then allowed to sleep. He slept peacefully for six hours and woke up feeling fairly well. Compound jalap powder and salts were administered and they acted freely once. At 10 a.m. the child seemed rather sluggish in intelligence, though quite conscious. The pupils were widely dilated and the corneæ dull. The tendon reflexes were a little sluggish. Speech was slow, but distinct. There was a distinct pause before any question was answered, though the answer, when given, was rational. Respiration was slightly prolonged. The temperature was normal, the pulse 88. He took liquid food well. *Liquor strychninæ*, caffeine citrate, aromatic spirits of ammonia, digitalin and brandy were given at requisite intervals.

At 4 p.m. the child was still quite conscious. Speech was slower, with a longer intermission between question and answer. Words were indistinct and there was considerable difficulty in swallowing. Voluntary movements of arms and legs were quite free. Respiration was easy, but slow and prolonged. The pulse rate was 80 in the minute.

At 7 p.m. his condition was very much worse. The pulse rate was 120, losing volume. Amyl nitrite was tried. No improvement resulted. Slight improvement occurred after more strychnine was given. Death occurred at 8 p.m. and was due to heart failure. Respirations, though slow, remained easy to the end.

The following points seem to me to be of interest. The snake was a small black one, the least venomous kind. The snake bit with extreme tenacity and had to be pulled off by a bystander. It thus had time to inject its full dose of poison. It bit on the bare skin. No effective attempt at first aid treatment was made. It was almost an hour and a half before he received medical assistance. In spite of this, it was sixteen hours after the child was bitten before he began to show any dangerous symptoms. Once he began to go down, nothing seemed to have the least effect on him. Since that case, twenty-three years ago, I have attended to sixty-one cases of snake-bite, mostly from black snakes, a few brown, but no tiger snakes. I have not had one patient that developed any dangerous symptoms. Several of the patients were rather lethargic for a few hours about twenty-four hours after being bitten.

I attribute these results to the efficient first aid treatment they received; one or more tight ligatures had always been applied and the wounds had usually been incised and permanganate of potash rubbed in.

Reviews.

BIOLOGICAL CHEMISTRY.

THE tenth edition of "Practical Physiological Chemistry", by P. B. Hawk and O. Bergeim, is a comprehensive book of 929 pages.[1] In this edition a serious attempt has been made to bring the text up to date, and the book has been "modified on the basis of replies received in answer to a *questionnaire* which was submitted to each teacher who uses the book in his classes". The growth of the science of physiological chemistry has been along such divergent

[1] "Practical Physiological Chemistry, A Book Designed for Use in Courses in Practical Physiological Chemistry in Schools of Medicine and of Science", by P. B. Hawk, M.S., Ph.D., and O. Bergeim, M.S., Ph.D.; Tenth Edition; 1931. Philadelphia. P. Blakiston's Son and Company. Royal 8vo., pp. 947, with illustrations, some of which are in colour. Price: $6.50 net.

lines that it is now impossible for any one person to be *au fait* with its every aspect. The authors have recognized this by handing over certain sections to various authorities, so that the book is beginning to take on the characters of a system of biological chemistry. The authors give all the usual standard methods for the quantitative analysis of blood, tissue and excreta constituents, and where methods are in a state of flux, the most recent modification is also given. For example, in the case of uric acid and phosphorus, the methods of Benedict and Youngbury respectively are given in advance of their publication. The general standard of the book remains of that high order which led to early editions being adopted as the text book of physiological chemistry in many universities. But, although no one could cavil at the choice of methods of analysis, still the "interpretation" of the significance of the findings does not always express modern opinion. For example, gastric chlorides are still interpreted by the authors as being due to neutralization of the hydrochloric acid by the regurgitation of duodenal contents. A large amount of the book is devoted to various aspects of metabolism, and the vitamins are fully considered.

The book has grown so large and covers such a wide field that it is natural to ask what are its functions. It is too full and comprehensive for an ordinary student course, and the laboratory worker doing any serious work always finds his way back to original articles, so that one feels that the greatest function of the present edition is as a book of reference for methods and a handy place to find the source of the original article, as the references are very fully given. The book should provide an excellent guide for the teacher of physiological chemistry.

We can confidently recommend the present edition as a reliable book of reference which is indispensable to the laboratory worker and of great value to senior students of biological chemistry.

ALLERGY.

To those interested in immunology and kindred subjects "Recent Advances in Allergy", by Dr. G. W. Bray, will make a special appeal.[1]

The author divides this admirable book into two sections; Part I treats of allergy in general, and Part II deals with the individual varieties of allergy. In the opening chapter are ably presented some of the points of dissimilarity that exist between the induced manifestations of anaphylaxis in animals and the spontaneous forms of allergy in man. This is followed by an interesting chapter on certain experimental observations on anaphylaxis and allergy in which the author rightly stresses the chemical basis of allergic phenomena. Until recent years the neurogenic theory of the cause of asthma has been accepted without serious criticism, but with the modern experimental study of allergic problems and in particular the biochemical aspect of its various forms, there has gradually evolved a mass of evidence in favour of a chemical basis for asthma. We are wholly in agreement with Dr. Bray in his contention that whilst nervous or psychic factors may provoke allergic reseponses, they do so only in a person who is primarily allergic or, in other words, has a peculiar chemical constitution which is the fundamental cause of his allergic idiosyncrasy.

Rhinologists will find the chapter on the nasal factor in allergic diseases very interesting. In this the author contends that in no case in which protein sensitization can be demonstrated should dependence be placed on nasal surgery. Should allergic treatment fail, then surgical measures may be tried. The mucous membranes of the nose are frequently boggy in allergic disease, but "when these specific allergens are removed, such conditions rapidly subside to normal".

In the second part of the book the writer discusses in detail asthma, hay fever, eczema, urticaria, migraine and other aspects of allergy. The volume is altogether an excellent contribution to the subject, and in addition to being well illustrated, it contains 1,660 references to the literature.

Notes on Books, Current Journals and New Appliances.

FIJI AND ITS PEOPLE.

NOT the least important part of anthropology is the study of the native mind. With the spread of civilization, however, opportunities for getting in touch with the primitive native are becoming rare. Students of this subject will turn eagerly to the "Journal of Thomas Williams, Missionary in Fiji, 1840-1853".[1] The original of the diary is one of the treasures of the Mitchell Library, and the publishers are to be congratulated on making available two such volumes, which cannot fail to interest, apart from missionaries, all lovers of history, science and anthropology.

Thomas Williams was born in Hornibrook, England, in 1815. In 1840, after a voyage occupying some 200 days, he and his wife landed at Lakemba, the most important of the islands comprising the windward group in the Fijian Isles. He has been described by Sir Basil Thompson in his book on Fiji as "the principal authority upon the state of society among the Fijians when Europeans first came among them", and Professor G. C. Henderson, of Adelaide University, who has edited the journal, and is himself the recognized authority today on the Fijian, says that the tribute is deserved. The missionary was an enthusiast, and in his daily writings he noted all the interesting things around him, faithfully recording, in addition to his teachings and habits of domestic life, the various customs of the natives, their methods of living and dress. He worked hard to impregnate the minds of these people with his ideals of truth and honesty. Some of the native customs were cruel and revolting, and he and his colleague, Dr. Luth, the founder of British medical practice in Fiji, waged a never-ending warfare against such practices as strangulation of widows and cannibalism. Careful lists are recorded of the many books he studied, and he made many translations of religious works into the native dialects. His enthusiasm triumphed over his constant ill health, and his thirst for knowledge and his anxiety to impart it made him an ideal missionary.

He and his wife and colleagues were imbued with that more than magnificent pioneering spirit which laughed at obstacles and triumphed over great difficulties. But it must be admitted that sometimes their interpretation of the native mind was coloured by their own preconceptions and hopes. The journal's value to the student has been doubled by the careful editing and interesting production. Professor Henderson travelled not only to the various islands in Fiji where Thomas Williams preached, but also to his birthplace in England, to secure additional data which would be of interest to the reader of this most valuable record.

THE JOURNAL OF THORACIC SURGERY.

A NEW publication, *The Journal of Thoracic Surgery*, has appeared. It is the official organ of the American Association for Thoracic Surgery and will be published every two months. Articles dealing with all phases of thoracic disease will be included. The first issue contains articles on subjects ranging from post-operative atelectasis to reflex relationships between the lungs and other viscera. The C. V. Mosby Company are the publishers.

[1] "Recent Advances in Allergy (Asthma, Hay-Fever, Eczema, Migraine, etc.)", by G. W. Bray, M.B., Ch.M., with foreword by A. F. Hurst; 1931. London: J. and A. Churchill. Demy 8vo., pp. 444, with 98 illustrations. Price: 12s. 6d. net.

[1] "Journal of Thomas Williams, Missionary in Fiji, 1840-1853", by G. C. Henderson, M.A.; Volumes I and II. 1931. Australia: Angus and Robertson. Royal 8vo., pp. 606, with illustrations. Price: 42s. net.

The Medical Journal of Australia

SATURDAY, JANUARY 23, 1932.

All articles submitted for publication in this journal should be typed with double or treble spacing. Carbon copies should not be sent. Authors are requested to avoid the use of abbreviations and not to underline either words or phrases.

References to articles and books should be carefully checked. In a reference the following information should be given without abbreviation: Initials of author, surname of author, full title of article, name of journal, volume, full date (month, day and year), number of the first page of the article. If a reference is made to an abstract of a paper, the name of the original journal, together with that of the journal in which the abstract has appeared, should be given with full date in each instance.

Authors who are not accustomed to preparing drawings or photographic prints for reproduction, are invited to seek the advice of the Editor.

THE SPIRIT OF RESEARCH.

THE slow, hesitating, clinging grasp of science, like that of the many-tentacled denizens of the sea, cannot be loosened or evaded. Through many trials and failures, let the superficial appearance which hides the precious truth be as polished and impenetrable-seeming as it may, a flaw will be found, a foot-hold gained, and atom by atom, through centuries if need be, the very heart of mystery is unveiled.

Thus wrote the late Thorburn Brailsford Robertson, sometime Professor of Physiology in the University of Adelaide. Scientific research has always been a mystery to the general public and something to be admired and possibly followed by practitioners of medicine and of the allied sciences; and all members of the community are apparently ready and willing to turn the discoveries of the investigator to their own pecuniary advantage. The man who devotes his life to research has seldom been understood by the non-scientific; and even those who use the fruits of research in their professional lives, do not always appreciate the motives actuating the investigator, nor have they any idea of the joy that comes when one small fragment of truth has been wrested from Nature's safe repository. Without doubt the cause of science would be furthered if wider understanding of the aims of scientific research and of the impelling force behind those who follow it, were brought about. With this objective the attention of people in every station of life is directed to "The Spirit of Research", a series of articles from the pen of the late Thorburn Brailsford Robertson, published in book form by his widow.[1]

To Brailsford Robertson the spirit of research was "that spirit which inquires for the purpose of making things better than they are, and which urges humanity towards higher purposes and more worthy achievements in every aspect of our lives". He states that if our object is merely to keep things going as they are, then all the activities of mankind become virtually nothing more than "housekeeping on a world-wide scale". It is a kind of false modesty indistinguishable from laziness to leave research for those with exceptional capacity for it, and to be content merely to enjoy and apply the fruits of their labours. "It is not the talents we possess so much as the use we make of them that counts in the progress of the world." But withal the investigator must always remember that in proportion as he devotes himself to research, so must he relinquish the desire for success; for the success, that is, of the kind expressible in cash and such as the world ordinarily esteems success. On reading statements of this kind, one comes to the conclusion that scientific investigators are almost as a race apart; and the mind flies at once to the words of another teacher who centuries ago taught his followers that they should be "in the world" yet not "of the world". Whether this separateness is necessary to work of the highest order may be debatable (Brailsford Robertson thought that it was), and here it is interesting to pause and to recall the recent discussions in the assemblies of the British Medical Association in England on the rights of research workers to take out letters patent to protect their financial interests. The conclusion is justified that if a research worker has one eye on patent rights and the other on his work, the work will suffer. This is equally true, of course, if his remuneration is inadequate and if he is not in a position to provide something more than the bare necessities of life for himself and his family. But this is perhaps a digression. Brailsford

[1] "The Spirit of Research," by T. Brailsford Robertson, Ph.D., D.Sc., Edited by J. W. Robertson; 1931. Adelaide: F. W. Preece and Sons; Sydney: Angus and Robertson. Crown 8vo., pp. 221. Price: 8s. 6d. net.

Robertson offers consolation. He held that, although consciousness of service may have to suffice as a reward, and although effort has apparently failed and the ears of the world have been deaf, if ever true service has been performed, its effects can never die. He urges all students of science to concern themselves not overmuch with success or with the possession or non-possession of those abilities which most readily gain recognition. He would have them endeavour diligently to expend all their capabilities upon the task in hand: "do the best you can with what you have where you are."

The spirit of research is best exemplified in the lives of those who shone as beacons in dark places. There have been many such luminaries, and Brailsford Robertson was not the least. It would be more correct to use the present tense, for his work lives, not only in what he himself created, but in the lives of students who received their training at his hands. This book is a book with a message; it reflects example as well as precept. We are more than glad it has been published, and would ask all medical practitioners to study it. We cannot do better than conclude with another quotation from Brailsford Robertson's writings:

> Then I turn to the one thing which will conquer and transform the world.
>
> I turn again to grope again in the void for new knowledge.
>
> I try to lift a torch in the surrounding blackness, which will one day lead to the new Greece, to the land of sunlight.

Current Comment.

DIABETES AND ITS COMPLICATIONS.

BEFORE the discovery of insulin the total life of the diabetic did not exceed six years, and the first year of diabetes was the most serious for the patient; now it is the safest. Coma is now considered as an accident or due to neglect. It has largely been replaced in the mortality of diabetes by arteriosclerosis, commonly manifested by gangrene, particularly in the ignorant and indigent. This question was discussed in this journal not long ago by L. W. Dunlop. Since the discovery of insulin diabetic mortality has decreased not only in the young, but in all ages below fifty. In all ages above sixty the mortality rises, especially in females. The commonest age for diabetes is fifty years for females and a year or two more for men. E. P. Joslin, in a recent communication,[1] states that in the United States of America the average age at death of the general population is forty-four years, and, unless preventive measures be taken, it may be anticipated that diabetes will continue to increase till the average age at death reaches the fiftieth year, that is, the leading year for the onset of the disease. Diabetes has increased especially in middle-aged women, because obesity, which is a predisposing factor to diabetes, is so prevalent at the menopause.

Joslin points out that the skin of the diabetic patient is vulnerable because it contains sugar instead of glycogen. If not supplied with glycogen, the muscles, especially the cardiac, are weakened. Possibly the *tunica media* of the arteries of the diabetic undergoes premature degeneration from lack of glycogen. Glycogen shortage and fat accumulation are characteristic of the diabetic liver of a patient on the verge of coma. All these may be corrected by insulin in adequate dosage. Because the environments differ, the hospital dose is not and cannot be the same as the home dose. More insulin is needed during an infection and the site of injection must be changed to obviate skin induration or insulin atrophies.

Joslin includes in his article a discussion on diabetic coma. This aspect of diabetes is discussed in the present issue by Downie and need not be mentioned further in this place. Since 1922 Joslin has had experience of 170 cases of coma with 23 deaths; autopsy in two instances revealed suppurative pancreatitis with fat necrosis.

Joslin refers to the view of Klots that insulin may act as a protection to the median muscular coat of the blood vessels. A generation ago diabetic patients succumbed to tuberculosis; half a generation ago they died in coma; now arteriosclerosis is the cause of death. Twenty-two of Joslin's diabetic children evidenced arteriosclerosis, but no child treated with insulin from the onset of the diabetes appeared to be thus affected. Insulin is of great help to diabetic patients with cardiac disorders, but hypoglycæmia, which is disastrous to a damaged heart, must be avoided. In Joslin's opinion one should speak of hypoglycæmic rather than of insulin angina. Diabetic patients with decompensated hearts often display remarkable gain in tolerance; hence diet and insulin dosage must be carefully watched. Joslin refers to the value of blood sugar estimations and points out that when they are used there is likely to be less confusion between diabetic coma and insulin shock. Incorrect interpretation of blood sugar estimations will expose the patient to danger. If a patient have blood sugar slightly above normal, with the urine sugar-free, there is no reason for radical alteration in his diet. It would almost be better if such patient's blood sugar concentration were not known. He should have liberal carbohydrate diet with much exercise combined with adequate rest, his surroundings should be hygienic and his weight should be maintained under careful observation. The twenty-four hour specimen of urine indicates the patient's

[1] *The Journal of the American Medical Association*, August 29, 1931.

condition for a whole day, but the blood sugar test discloses the condition for only a single instant. If the carbohydrate in the diet be lowered, the patient's tolerance may also be lowered. Joslin believes that the development of diabetes is not unusual as the result of radical restriction of carbohydrates in treating obesity. Ten years ago a diabetic patient was regarded as most unsuitable for surgical operation; today it is a graver risk to withhold operation.

Though not mentioned by Joslin in this article, the use of histamine has been of the greatest value in studying arteriosclerosis in the diabetic. R. Brooke has pointed out that there are some cases of diabetic gangrene which end fatally in 48 to 72 hours with rapidly progressing gangrene of one or both limbs. The spread of the gangrene is so rapid, even with insulin treatment, that operative measures are not successful. He has recommended periarterial sympathectomy of the femoral artery in Hunter's canal with ligation of the femoral vein, followed (in from five to ten days) by low amputation. W. R. Campbell states that gangrene of the feet in diabetics can generally be ascribed to lessened blood supply owing to arteriosclerosis. J. Starr examined one hundred unselected diabetics with the histamine test. A normal circulation in the feet was present in 32%. In 34% the circulation was somewhat impaired, and in an equal percentage it was considerably impaired. Together with the physical findings, the histamine test aids in the detection of pathological changes in the minute blood vessels. It is considered that a better prognosis is possible if the result of the histamine test be considered with the physical findings than if either be employed alone. It does not seem that arteriosclerosis and cholesterol values proceed *pari passu*. Vascular sclerosis tends to increase with the duration of the diabetes. The relation of hypertension to diabetes and to vascular sclerosis in diabetes is not clear. Many diabetics have arteriosclerosis without hypertension. It is believed that hypertension is more common in diabetics than in non-diabetics. S. F. Adams, however, concludes that the blood pressure of diabetics does not furnish evidence that hypertension is caused by diabetes. It has also been considered that neither glycosuria nor acidosis contributes directly to diabetic neuritis, but that arteriosclerosis is the main factor in its production. The recent discovery of a new pancreatic hormone by Professor Santenoise may alter the treatment of diabetes. If this hormone be combined with insulin the disappearance of glycosuria is possibly more lasting and the tolerance for carbohydrates is increased so that a less "severe" diet may be allowed to the patient with less insulin.

TREATMENT IN POLIOMYELITIS.

IT should not be necessary at the present time to emphasize the value of serum treatment in poliomyelitis, but since interest begets action, reference may be made to a report by E. B. Shaw, H. E. Thelander and M. A. Limper on results obtained in one hundred and four cases.[1] Serum was given to 92 of the 104 patients. Of 53 patients treated before the onset of paralysis, 28 gave no evidence of paralysis at any time, 15 manifested transient weakness which disapeared entirely before their discharge from hospital, nine had persistent paralysis, and one died. The average age of the unparalysed patients was nine and a half years, of those with transient paralysis ten years, and of those with definite paralysis seventeen years. The time that elapsed between onset of symptoms and administration of serum was 2·7 days in the unparalysed group, 3·6 days in the group with transient paralysis, and 3·4 days in those with persistent paralysis. Thirty-nine patients were treated in the acute stage after demonstrable weakness; in nine the weakness was transitory, 23 had persistent paralysis, and seven died. The time interval between onset and the giving of serum in these three groups was 3·7, 4·2 and 6·3 days. The amount of serum used in the group of patients treated before paralysis appeared averaged 120 cubic centimetres for those who did not become paralysed, 151 for those with transient paralysis, 209 for those with persistent paralysis, and 375 cubic centimetres for the patient who died. The amount of serum used for those treated in the acute stage after weakness appeared was 84 cubic centimetres for those with transient paralysis, 150 for those with persistent paralysis, and 156 for those who died.

Shaw and his collaborators point out that it is unfair to attempt to compare results in the two groups of 53 and 39 patients, because, while the first contains at least a few "benign cases", the second included many "extremely virulent cases". In spite of this the report carries an obvious lesson.

THE LATE ROBERT HENRY TODD.

AT a meeting of the Council of the New South Wales Branch of the British Medical Association on January 5, 1932, it was decided to perpetuate the memory of the late Robert Henry Todd by the foundation of a prize in medical jurisprudence at the University of Sydney. He was Lecturer in Medical Jurisprudence and on one occasion expressed the wish that his name might be associated with a prize to be awarded at the annual examination. Subscriptions, forwarded to the Medical Secretary of the New South Wales Branch of the British Medical Association, 135, Macquarie Street, Sydney, will be acknowledged in this journal.

On Sunday, February 21, 1932, the "Robert H. Todd Assembly Hall" at the British Medical Association House, Sydney, will be dedicated in his memory. This day has been chosen in the hope that representatives from the Branches in other States will be able to attend. An account of his career will not be published until after the dedication ceremony.

[1] *The Journal of the American Medical Association*, November 28, 1931.

Abstracts from Current Medical Literature.

GYNÆCOLOGY.

Carcinoma of the Uterus.

V. BONNEY (*The Practitioner*, June, 1931) deals with the diagnosis and treatment of carcinoma of the cervix and of the *corpus uteri*. He finds that malignant changes of the cervix are the more common and have a very wide age incidence when compared to cancer of the body, which in 80% of cases occurs between the ages of fifty and sixty-five years. Carcinoma is rare in virgin women. The vast majority of patients have borne children. The combination of chronic cervicitis with scar tissue, the result of birth injury, is the common forerunner of malignant changes of the cervix. On the other hand, carcinoma of the body is rather commoner in virgin women. The author is of the opinion that the presence of fibroids tends to produce endometrial changes probably conducive to the development of carcinoma of the body. The classical signs of carcinoma of the uterus are hæmorrhage, discharge, pain, in that chronological order. Pain is usually a late symptom, but this is not true for all cases. Bonney has found that whenever the growth starts on the vaginal surface of the cervix an erosion is invariably present, and that carcinoma never besets a healthy cervix. With the exception of the scirrhous type, carcinomata bleed more readily than the inflammatory lesion they resemble. It is rare to find carcinoma developing during the full menstrual life; it is at or about the climacteric that these changes develop. When carcinoma develops before the climacteric it is usually associated with fibroids. It may be taken as a rule that a diagnosis of fibroids made for the first time after the menopause is in all probability incorrect.

Treatment of Salpingitis.

H. MONTAG (*Monatsschrift für Geburtshülfe und Gynäkologie*, June, 1931) describes the action of injections of the anterior pituitary hormone "Prolan" in cases of salpingitis and pyosalpinx. He has found that it will give better and quicker results than douching or diathermy. It causes intense pelvic congestion which will gradually cure most inflammatory pelvic conditions. The relief of pain is immediate and the general condition of the patient rapidly improves. In nine cases of salpingitis and sterility three instances of pregnancy and normal delivery were noted following treatment. The injections did no harm, provided they were used with subacute or chronic infections. In the acute stage increased temperature and pain were invariably associated with its use. No patient was treated until she had been afebrile for at least a fortnight. The initial dose was 60 units, increased to 100, and these were given at two or three days intervals. The total number of injections varied from six to eighteen. In a series of 61 cases the author had only 10% of failures.

Hysterectomy and Ovarian Function.

N. PARFENOFF (*Monatsschrift für Geburtshülfe und Gynäkologie*, August, 1931) describes his results with white mice on the effect on the ovaries of removal of the uterus. In general this causes marked and progressive degenerative alterations in the ovaries with disturbances in their functional activities. These degenerative changes are most pronounced in the follicular portion of the ovary and do not appear to depend on interference with the blood and nerve supply due to the hysterectomy. The uterus apparently produces a hormone acting on the ovaries through the vascular system, but so far this hormone has not been isolated. Removal of the uterus stimulates development of the interstitial gland, which in its turn produces atrophy of the Graafian follicles by pressure. He concludes that the mechanism whereby the uterus affects ovarian function still remains unsolved, despite all the work already published.

Climacteric Hæmorrhages.

K. TIETZE AND C. MAYER (*Monatsschrift für Geburtshülfe und Gynäkologie*, June, 1931) have investigated the causes of uterine hæmorrhage in a series of 367 patients at and after the menopause. While many causes have been noted, the preponderance of carcinoma, especially in the latter group, is noteworthy—two-thirds of the cases. The most frequent cause at the climacteric is *metropathia hæmorrhagica*, while polypi were third in the list (10% to 12%), both before and after the menopause. Fibroids were responsible for 7·9% of the menopausal group and only 0·5% of those at a later stage. Erosions were noted as the cause in 3% and 6·7% respectively. The survey emphasizes the importance of a careful investigation of all bleeding at the menopause and an investigation which also includes microscopical examination of uterine scrapings and sections of suspicious tissues when necessary.

The Placenta as an Organ of Internal Secretion.

L. SEITZ (*Münchener Medizinische Wochenschrift*, May 22, 1931) puts forward the claim of the placenta as an endocrine organ. The chorionic epithelium constitutes an organ which transmits the materials necessary to the building up of the fœtus. From time to time chorionic elements are swept away into the maternal circulation, and it is possible that the product of their destruction acts in some way as a stimulus to the maternal organism. In addition to these functions, however, the author attributes a further endocrine importance to the placenta. The female body undergoes marked changes in its endocrine activities, the most definite of which are the production of a large amount of hormone from the anterior lobe of the pituitary, from the ovary and the thyreoid. The relation of the placenta to these organs is, according to the author, a very definite one, although its actual position in the endocrine system is still unknown. Its entrance into such a system sets up a new "hormonal equilibrium". This in the majority of women is a pure physiological process, and in such cases the health of the individual is undisturbed. If the body, however, lacks this ability to adjust itself to the new set of endocrine conditions or if the pregnancy is abnormal in the direction of a hydatid mole or twin pregnancy, then symptoms appear which vary in intensity up to a degree at which life itself is endangered. These disturbances generally are of two kinds—upsets of the endocrine organs themselves, and secondly, of the body metabolism. Among the former are a tendency to acromegalic proportions, *diabetes insipidus*, adiposity, and wasting of a pituitary type, osteomalacia, vasomotor symptoms of ovarian origin, and a pregnancy tachycardia probably thyreoid in origin. The author suggests such disturbance as a possible cause of the toxæmias of pregnancy, and points out that eclampsia occurs generally in the earlier months of hydatid mole and multiple pregnancy, whereas in ordinary pregnancy it is not seen until the latter half of the gestation period. In all of this profound change consequent on pregnancy, the placenta plays an important rôle. The constitution of the patient determines her reaction to such, sometimes in a feeling of improved health, while in others it leads to organic damage and even to a fatal result.

Alcohol Injections in Gynæcology.

R. HOFSTATTER (*Monatsschrift für Geburtshülfe und Gynäkologie*, September, 1931) discusses the use of injections of 90% alcohol for various lesions met with in gynæcological practice, especially hæmorrhoids and dysmenorrhœa. For some time it had been his practice after vaginal plastic operations to inject any hæmorrhoids with alcohol. Beyond slight trouble with moist gangrene of the injected masses he had no complications until one patient developed extensive gangrene of the perianal area. Since then he has returned to the use of the cautery or ligature and excision as being safer. Injections of alcohol have also been employed for intractable dysmenorrhœa. The needle is inserted somewhat posteriorly in relation to the cervix and the cervical ganglia which lie above the uterosacral ligaments are injected. In three cases success was obtained, but with a fourth similar trouble was encountered as above described. Since then he has employed "Novocain" with better results.

OBSTETRICS.

Cæsarean Section Through the Lower Segment.

J. ST. GEORGE WILSON (*The Journal of Obstetrics and Gynæcology of the British Empire*, Autumn Number, 1931) discusses the advantages of the lower segment Cæsarean operation. The author follows Munro Kerr and makes a transverse incision in the lower uterine segment. In all cases he removes the placenta through the incision. Technically, the operation becomes easier the longer the patient is in labour. The average duration of labour in the author's series of 50 cases was 15·3 hours; the longest was 92 hours. Rupture of the membranes was noted in 23 patients; their highest average temperature was 37·8° C. (100·1° F.). There was one death from peritonitis, that of a patient on whom a stomach tube had been used to start labour. The author claims that many Cæsarean sections can be avoided if this type of operation is used, as a better trial labour can be given. The smoothness of the convalescence of the mother is a pleasing feature, the upper abdominal distension being much less. No rupture of the scar was reported, some of the operations dating back five years.

Induction of Labour by Puncture of the Membranes.

GIBBON FITZGIBBON (*The Journal of Obstetrics and Gynæcology of the British Empire*, Autumn Number, 1931) advocates the induction of labour by the puncture of membranes. He adopted this method on *multiparæ* during the latter part of his Mastership at the Rotunda Hospital. In a series of 23 patients, 17 *multiparæ* and six *primiparæ*, he practised this method in private practice. The results have led him to the conclusion that puncture of the membrane is a certain and safe manœuvre and causes no undue delay in delivery. He is of the opinion that the onset of labour is purely mechanical and results from stimulation of nervous impulses by the pressure of the presenting part on the parametric tissue surrounding the internal os and supravaginal portion of the cervix. In rupturing the membranes it is important that the examining finger should be against the head and push it up to allow the liquor to escape and the head to fit snugly into the cervix. There was one fœtal death following a version for contraction ring dystocia; death was due to delay in delivering the aftercoming head.

"Pernocton" Treatment of Eclampsia.

H. GOECKE (*Monatsschrift für Geburtshülfe und Gynäkologie*, June, 1931) reviews his results following the administration of "Pernocton" to 34 patients with eclampsia. The usual dose of one cubic centimetre to every 12·5 kilograms body weight could not be calculated owing to the physical condition of the patients. Another source of difficulty was the increase of weight due to the general œdema present. Therefore it was decided to give six cubic centimetres on an average. The drug was administered intravenously at the rate of one cubic centimetre every minute. In only four cases out of 31 did fits recur after delivery, as compared with nine in a similar control series otherwise treated. Following injection there was a slowing of respiration with increased cyanosis and rapid pulse, but these were evanescent. The majority of patients were fast asleep before the injection was finished. In some cases forceps delivery was possible without further anæsthesia. If birth occurred shortly after the injection, the infants appeared to be rather asphyxiated, resembling those with morphine-scopolamine narcosis. The blood pressure was unaffected. "Pernocton" was used with three cases of *post partum* eclampsia with complete cessation of fits.

F. FRETCOURST AND F. B. RUDER (*ibidem*) advocate the use of "Pernocton" not only for eclampsia, but as a routine sedative for all cases of labour. They gave seven to eight cubic centimetres at the end of the first stage. The progress of labour was unaffected in most cases, and any slight inertia was overcome by small doses of pituitary extract. The fœtal heart rate was unaffected and the amount of blood lost in the third stage, unlike the loss with "Avertin", was well within normal limits. The only symptoms noted were slight pallor and some lowering of blood pressure. There was slight *asphyxia neonatorum*, but this was of no importance. Despite careful urinary analysis, they were unable to detect any traces of the drug in the fœtal urine or circulation. It was also used successfully before general anæsthesia for gynæcological operations. The usual dose was one cubic centimetre per 12·5 kilograms body weight, and this was given thirty minutes before operation.

The Treatment and Prognosis of Puerperal Peritonitis.

W. v. REHREN (*Münchener Medizinische Wochenschrift*, May 22, 1931) claims an improvement in the usually hopeless prognosis of generalized puerperal peritonitis (post abortal). This follows the early recognition of the condition and drainage of the peritoneal cavity by a combined colpotomy, and drainage of the pelvis from above. This method of treatment, he asserts, has resulted in the saving of over 50% of patients in 1930, as against the more usual figure of practically nil. Simple drainage of the pouch of Douglas *per vaginam* is not sufficient, the essential additional drainage through "pararectal" incisions being the really life-saving measure. He quotes illustrative cases and insists that failure to obtain pus is no contra-indication to drainage. The "opening up" of an occasional abdomen unnecessarily is a laudable error, whereas the too late recognition of an established peritonitis is a far greater mistake. The actual technique is carried out under light general or local anæsthesia. Meticulous care is taken to leave untouched any adherent coils of intestine, and a tube is passed very gently into the pelvis, any pus is carefully swabbed away, but no irrigation is allowed. The combined laparotomy and Douglas's pouch drainage improve the otherwise hopeless prognosis of the condition, which usually occurs in young women between twenty and twenty-five years of age.

Liver Changes in the Toxæmias of Pregnancy.

K. ROSENLOECHER (*Monatsschrift für Geburtshülfe und Gynäkologie*, June, 1931) discusses the changes in the liver produced by eclampsia and *hyperemesis gravidarum*. The details of several cases are given. In one case of hyperemesis with slight jaundice eclampsia finally developed. The autopsy findings were those of acute yellow atrophy—central necrosis of the hepatic lobules. In another case of hyperemesis in which gradual improvement occurred, although vomiting never completely ceased, death followed forceps delivery at term. The *post mortem* findings were those of toxic spoiling of the liver. The lesson to be learned from both cases is that excessive vomiting of any duration is liable to be associated with gross hepatic lesions which will inevitably lead to a fatal issue, no matter what method of delivery is used.

Wassermann Test During Pregnancy.

W. HILDEN (*Monatsschrift für Geburtshülfe und Gynäkologie*, September, 1931) discusses the value of the Wassermann test when retroplacental blood is used. He has employed this method in 3,500 cases and in 121 he obtained positive results. All positive results were controlled on the seventh day by blood withdrawn from the arm. The results were equally correct, and he considers that the use of retroplacental blood for the test is justified. Few non-specific reactions were observed, and the percentage of these has steadily decreased with the use of a more exact technique. Naturally, one positive result was not regarded as sufficient evidence of syphilis, and repeated tests were done until the diagnosis was clarified.

The Healthy Smell of the Newly Born.

W. HILDEBRANDT (*Münchener Medizinische Wochenschrift*, March 13, 1931) draws attention to a characteristic smell of the breath of an infant between the second and fourth days after birth. It has some semblance to acetone and is reminiscent of violets or tulips. No acetone has been detected in the urine, and the author leaves it an open question as to whether the smell is emitted primarily by the infant or is transferred to it by the mother.

Special Articles on Aids to Diagnosis.

(Contributed by Request.)

XII.

BASAL METABOLISM ESTIMATION.

THE value of a laboratory test is proportional to the assistance it affords the clinician in accurately measuring the deviation from normal of a body function, and to its ability to record progress of that function. Estimation of the metabolism provides an accurate measurement of the level of heat production, which in turn is an index of the rate of cell oxidation. In an individual the basal rate of cell oxidation is determined principally by the amount of circulating thyroxin. Certain inherent qualities of the cell itself also play a part, for example, the metabolic activity of all cells decreases progressively with the age of the individual, just as does the amount of water in the cells. Sex also affects the rate of cell activity. The female organism lives at a lower metabolic rate than the male. By adopting certain normal standards for the two sexes at different age periods, deviations in an individual from these standards can in general be considered to be due entirely to changes in the amount of circulating thyroxin. It is true that the secretion of the adrenal glands directly affects the rate of cell oxidation, but under true basal conditions there is no stimulation of these glands that would be sufficient to affect the metabolism.

The rate of cell oxidation can be affected by body temperature, food ingestion, muscular exercise, but in determining the basal metabolism the oral temperature must be normal, the patient must be fasting, and complete muscular relaxation insured by an adequate rest period. The patient must be comfortably warm. Given standard conditions, the basal metabolism remains constant over considerable periods of time. In some subjects it has remained constant over a period of many years.

While methods of determining the basal metabolism are beyond the scope of this article, it is necessary to stress the fact that for accurate results it is essential to determine both the production of carbon dioxide and the consumption of oxygen during the experimental period. Any method that depends solely on one or the other and assumes a constant respiratory quotient in the calculation is based on unsound principles of the physiology of tissue exchange. The respiratory quotient, which is the relation of the expired carbon dioxide to the retained oxygen, was originally considered to represent the end result of the combustion of varying proportions of protein, carbohydrate and fat for energy production, but as Cathcart points out, the respiratory quotient represents the summation of all the various catabolic and anabolic processes going on in the organism approximately at the time of the test. If a constant respiratory quotient of 0·82 is assumed, gross errors are possible in individual cases, because disease, therapeutic agents, individual idiosyncrasies and the artificial type of respiration obtaining during the test may all influence the relation between the carbon dioxide and oxygen in the expired air. In the theoretically ideal and normal patient either the carbon dioxide or oxygen would be sufficient. In the practice of clinical metabolimetry, long experience has convinced me that it is fallacious to depend on either alone.

From the practical clinical point of view, the estimation of the basal metabolism is essentially a test of thyreoid function. The clinician suspects either an increased or decreased production of thyroxin, or with manifestations of dysthyreoidism he wishes to determine the level of the basal metabolism. Apart from definite cases of hyperthyreoidism, there occur numerous cases of various types of goitre in patients who exhibit a wide variety of symptoms, and it is often important to determine the amount of thyroxin being produced in any given case. When a patient presents tachycardia or nervousness or wasting as almost the sole symptom, and in the absence of any obvious cause for such symptom, I have frequently seen the basal metabolism definitely raised, and subsequent events have proved that a diagnosis of hyperthyreoidism has been justified. Symptoms which may or may not be due to hyperthyreoidism frequently develop in patients who have had a swelling of the thyreoid gland for years. In such patients, especially if the gland is at all large, it is possible for a considerable degree of hyperthyreoidism to be present without any diagnosable hyperactivity of the gland. In these patients estimations of the basal metabolism are particularly valuable to clinch the diagnosis.

There is a definite clinical entity—sympatheticotonia—in which all the symptoms and some of the signs of hyperthyreoidism may be present. In such patients many authorities rely almost entirely on estimations of the basal metabolism for a differentiation from true hyperthyreoidism. This group of cases is very difficult, but important. Quite a few persons so affected have slightly enlarged thyreoids, and some, in spite of a normal basal metabolism, have been operated on. Their after-histories have been ascertained, and almost without exception, after a short period of relief from symptoms, their condition has relapsed.

Apart from thyreoid conditions, the test is of value in many cases of obesity, arthritis, diabetes, dermatitis, because the thyreoid gland is often also involved in these diseases.

I shall now deal in more detail with the value of estimations of the basal metabolism in various types of cases.

Hyperthyreoidism.

The diagnosis of hyperthyreoidism in frank cases is a simple matter, but an estimation of the absolute amount of hyperthyreoidism is important as a guide to the type and time of treatment other than medical. Repeated tests indicate whether improvement is going on, and most surgeons now will operate only when the metabolism is falling, or has fallen and is stationary. Surgical interference during an exacerbation is often followed by disaster. The initial degree of elevation of the metabolism is a good guide as to the amount of thyreoid tissue that should be removed, and repeated tests after operation indicate whether further surgical interference is required. It is a routine with surgeons at the Royal Prince Alfred Hospital to have the metabolism estimated frequently before operation, and at three months, six months and a year after operation. Since the introduction of this routine the end results of cases so controlled have been definitely improved. Several of the surgeons at the Royal Prince Alfred Hospital are guided very largely by the basal metabolic rate, and often perform further operations, even after a wide removal of three-fifths or more of the original tissue, when the basal metabolism at intervals after operation has remained definitely elevated or has gradually risen. The capacity for hypertrophy in the thyreoid remnant varies enormously in different patients, and in one remarkable patient of Dr. Poate, a female, who first had a thyreoidectomy at the age of sixteen, in 1925, and who has had two subsequent operations *plus* a complete course of X ray therapy, the remnant, which consisted after the third operation of a small piece of the left lower lobe, has hypertrophied to a mass of considerable size, and the metabolism has risen to a constant level of from 20% to 35%, as observed during the last twelve months. Such an extreme capacity for hypertrophy is fortunately rare, but it is not uncommon for considerable hypertrophy of a small remnant to necessitate a subsequent operation. Before the days of basal metabolism estimations it was not a usual practice to subject patients to further operations after thyreoidectomy, but, guided by the basal metabolism, surgeons now perform a second operation, the object being to restore the metabolism to normal. The favourable end result of the patient's general condition justifies a reliance on a normal basal metabolism as the principal criterion of "cure" of hyperthyreoidism, though, of course, heart damage *et cetera* may remain.

Post-operative myxœdema, or better, hypothyreoidism (because, though hypothyreoidism may supervene within a few months after operation, in my opinion the picture of myxœdema takes at least a year to develop), is much more accurately determined by estimation of the basal metab-

olism at regular intervals than by depending on symptoms to appear. In many cases it has been remarkable how few signs or symptoms have been present with a very low basal metabolism after operation, yet, nevertheless, a marked improvement can be appreciated by the patient when the basal metabolism returns to normal with the administration of thyreoid extract. The chief features of post-operative hypothyreoidism are the subjective feeling of cold and tiredness, but the improvement is one of enhanced "well-being", that intangible state which cannot be expressed or diagnosed, but which we all appreciate at some time or other, as, for example, after a holiday, even though we were not conscious of not feeling well before.

Adenoma of the Thyreoid.

Unfortunately, a drift from the study of the pathological material removed at operation has led in certain quarters to the growth of a scepticism of the reality of adenoma of the thyreoid gland; an examination of the operative material soon converts the sceptic. Adenomata of the thyreoid are definitely encapsulated tumours which have very varied histological pictures and consequently physiological effects, all types of tissue, from marked hyperplasia to gross degeneration, being found. Furthermore, the effects on the gland itself have also to be considered; any state may be present, from compression with hypothyreoidism to stimulation with hyperthyreoidism. So that, with the typical picture of a toxic adenoma with symptoms of heart failure, cardiac irregularity, and especially auricular fibrillation, and with a variety of nervous manifestations, the question of hyperthyreoidism is often difficult to determine clinically, as all the "toxic symptoms" may be present without hyperthyreoidism; and in such cases a knowledge of the basal metabolism is of great value in assessing how much the clinical picture is a result of a dysfunction due to the adenoma *per se*, and how much to a complicating hyperthyreoidism. Here one may interpose the interesting fact that several cases of adenoma with dysfunction associated with hypothyreoidism have been converted into permanent dysthyreoidism with hyperfunction following the administration of thyreoid extract. Indeed, from a study of the basal metabolism in cases of localized thyreoid swelling, one would conclude that, when possible, the most rational therapeutic procedure is removal of the adenoma by decapsulation. Such an operation frequently allows the remaining gland to be restored to normal functional activity.

Myxœdema and Hypothyreoidism.

Estimations of the basal metabolism are probably of more importance in hypothyreoidic states than in any other, for thereby we can determine with considerable precision the amount of thyreoid extract required to restore the patient to normal, and by subsequent tests keep the patient's metabolism at a normal level, which means the greatest efficiency for the individual. For, though it is a common observation that the administration of excess of thyreoid extract gives rise to symptoms such as tremulousness and tachycardia, which soon arouse doctor and patient to the fact, it is often not appreciated that hypothyreoidic patients give up taking an adequate dosage and unconsciously drift back to a pathological state. Indeed, I should like to make a point of stressing the importance of periodic estimations of the basal metabolism in the treatment of hypothyreoidic patients.

The Obesities.

From the metabolic point of view the problem of obesity is very difficult and reveals many gaps in our knowledge of metabolism in general. A proportion of obese people have a low basal metabolism; the great majority have a heat production greater than normal. Whether this heat production is real or is only apparent and due to anomalies in our calculation of surface area in fat subjects or in heat insulation due to the adipose deposits, awaits elucidation. It seems futile to expect people whose basal metabolism is greater than normal, to benefit from thyreoid medication, and I have seen a sufficient number who have been so generally upset, to compel me to draw the conclusion that thyreoid extract is definitely contraindicated in obesity unless the basal metabolism is below normal. But the problem is complex, because in obese patients whose basal metabolism is subnormal, it is a common observation that a much larger dose of a potent thyreoid extract can be tolerated than one would calculate from the data. In so-called pituitary obesity, Fröhlich's syndrome, the basal metabolism is frequently much below normal, and patients so affected have definitely been found to benefit when the metabolism is brought to a normal level. Carefully controlled cases, however, also show that the improvement is more marked if whole gland pituitary extract is given at the same time. In pathologically obese people, apart from the problem of the basal metabolism, that of the cause of the laying down of fat and of the general metabolism is very perplexing.

Summary.

To sum up:

As a clinical test, estimation of the basal metabolism is of considerable value. It is of most frequent use in estimating the degree and following the course of hyperthyreoidism.

It is of great use in estimating the degree of hypothyreoidism and in controlling thyreoid administration.

In pituitary disorders and in obesity it can be used to determine the advisability of thyreoid administration.

In diabetes it is of value in determining the caloric requirements of a patient.

In arthritis it is of value in determining whether there is a degree of hypothyreoidism present.

It is perhaps of greatest use for individual patients who complain predominantly of one symptom, such as tachycardia, palpitation, dyspnœa, nervousness, loss of weight *et cetera*, and when physical examination fails to reveal any definite pathological state. Each year one sees many such patients, and the basal metabolism is able either to determine the presence of hyperthyreoidism or definitely to exclude it.

F. S. HANSMAN,
M.B., Ch.M. (Sydney), M.R.C.P. (London),
Honorary Director, Department of Biochemistry, Royal Prince Alfred Hospital, Sydney.

British Medical Association News.

SCIENTIFIC.

A MEETING OF THE SOUTH AUSTRALIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION was held at the Darling Building, University of Adelaide, on October 29, 1931, DR. ST. J. POOLE, the Vice-President, in the chair.

Disabilities of the Knee Joint.

DR. L. O. BETTS read a paper entitled: "Disabilities of the Knee Joint" (see page 116).

Musculo-Spiral Paralysis.

DR. LEONARD LINDON showed a young man who at the date of admission to the Adelaide Hospital, in March, 1927, was seventeen years of age. As the result of a motor car accident, this man was admitted with a compound, comminuted fracture of the middle third of the right humerus. The arm was attached to the trunk by the inner head of *biceps brachii*, long head of triceps, the median and ulnar nerves, a bridge of skin five centimetres (two inches) wide and the brachial artery, which was exposed in the wound. The pulse was present at the wrist. Fragments of bone were lying loose in a very contaminated wound. There was a gap of about 7·6 to 10·0 centimetres (three to four inches) in the soft parts of the posterior aspect of the arm, including about this length of the musculo-spiral nerve.

Amputation was advised, but Dr. A. M. Cudmore, when called in consultation, considered that an attempt should be made to save the arm, in view of the integrity of the artery and median and ulnar nerves.

Accordingly, the contaminated tissues were thoroughly excised, bone fragments removed, and the bone ends "stepped" and wired with silver wire. Two Carrel's tubes were sutured into the wound and the soft tissues brought together loosely, as far as possible. With a constant "Eusol" drip the wound made rapid progress, and an X ray examination made four weeks after the accident showed the presence of bony callus. Meanwhile the forearm had been splinted to relax the paralysed muscles. At this stage, unfortunately, the patient absconded from hospital and was not seen again for some months.

He was readmitted in December, 1927, for the removal of the silver wire, down to which a sinus had persisted. The humerus was firmly united. The wire was removed, together with several small sequestra, a Carrel's tube inserted and the wound loosely closed. Twenty days later the wound was healed.

As the length of nerve lost entirely precluded any hope of nerve suture, it was decided to perform a tendon transplantation. This was done on January 5, 1928. The operation consisted of the following transplants: (i) The *pronator radii teres* into the tendons of the *extensores carpi radialis longior et brevior*. (ii) The *flexor carpi radialis* into the tendons of the *extensor ossis metacarpi pollicis* and the *extensor primi internodii pollicis*. (iii) The *flexor carpi ulnaris* into the tendons of the *extensor pollicis longus, extensor indicis, extensor communis* and *extensor minimi digiti*.

For three weeks the wrist and fingers were kept fully extended in plaster and were then kept extended on a splint. The immediate result appeared to be very satisfactory, but he again became restless and impatient of the lengthy treatment, and six weeks from the date of transplanting the tendons he was fruit-picking at Renmark, when he felt something "give" in his wrist. This proved to be the sutures uniting the *flexor carpi ulnaris* to the common extensors of the middle and ring fingers.

At the time of the meeting he had very imperfect extension of the elbow, as he had only the long head of the triceps intact. Dr. Lindon said that, all things considered, the patient had reeducated himself so well that he had recovered excellent extension of the wrist and fingers (with the exception of the middle and ring fingers referred to above) and of the thumb, so that for nearly three years he used an axe in a surveying gang in the Telephone Department; he could roll his cigarettes and play the violin.

He also illustrated the point that internal splinting of a compound, contaminated fracture by means of silver wire or plates was not only permissible, but was often the only means of maintaining adequate apposition of the fragments, always provided that the wound was freely drained and disinfected by Carrel's method after a free excision of the contaminated tissues, and provided that this was done within a few hours of the accident.

Paraphenylenediamine Poisoning.

DR. W. J. CLOSE reported a case of chronic poisoning by paraphenylenediamine, "Inecto" hair dye, which presented some problems in diagnosis, the most serious condition to differentiate being a cerebello-pontine tumour. By reference to the literature he stressed the dangers of the chemical and the lack of protection given by legislation.

Urinal for Female Patients.

Dr. Close also showed a simple form of urinal designed especially for a female spastic paraplegic patient, to whom the usual pattern was useless.

Chorioiditis Apparently Tuberculous in Origin.

DR. D'ARCY COWAN showed a patient who was seen by him in August, 1926, through the courtesy of Dr. R. H. Pulleine. The patient was then aged twenty-five years and was married. He was suffering from a central chorioiditis, of about twelve months' standing, which was interfering considerably with vision. His upper incisor teeth were notched and of the Hutchinson type. Dr. Pulleine stated that antisyphilitic treatment had resulted in no improvement. The Wassermann test gave no reaction. Apart from the defective vision, he enjoyed good health, led an active life, and participated in sport. Except for the teeth and the local pathological condition in the eyes, there were no abnormal physical findings. There was a strong family history of tuberculosis; both father and mother were said to have died of it, and one sister living suffered from a tuberculous trouble. The patient gave a very strong reaction to both a von Pirquet and a subcutaneous test. He was treated with tuberculin up to December without any other measures, either local or general. During this time his vision improved markedly and he was able to carry on at his work as a teacher without difficulty. There was a relapse in June, 1927, and he was treated again up to December, the final dose being 0·25 cubic centimetre of old tuberculin pure. His vision was then good and he remained well for four years. In September of this year he was again referred to Dr. Cowan by Dr. Pulleine on account of a recurrence of the chorioiditis with marked diminution of vision, which was handicapping him severely. He was tested with tuberculin and found to be very sensitive. At the time of the meeting he was under treatment with tuberculin and was responding satisfactorily. This seemed to be a case of central chorioiditis apparently tuberculous in origin. The association with notched teeth naturally suggests a syphilitic origin, but there was no evidence if this and antisyphilitic treatment seemed to make him worse.

Fibroid Degeneration with Red Degeneration.

DR. ROLAND BEARD showed a specimen of a fibroid uterus with red degeneration. Before operation the abdominal tumour was the size of an eight months' pregnancy. Menstruation had been quite regular without menorrhagia, and the patient was a *multipara*, aged forty years. She had been admitted with sudden severe right ilio-pelvic pain and moderate fever and abdominal tenderness. A preoperative diagnosis had been made of uterine fibroids with degenerative changes. Operation disclosed a large fibroid uterus with very extensive necrobiosis. The mass caused some difficulty in removal, but the patient's recovery was uninterrupted.

Interstitial Ectopic Pregnancy.

DR. C. DUGUID showed the placenta and fœtus from an interstitial ectopic pregnancy in the fourth month. The placenta had grown into and split up the muscle of the right side and the top of the uterus. It was lying against, but had not abrupted, the mucous membrane. The right tube was thicker than the left, but showed no localized swelling. The whole uterus was enlarged. Bimanual examination had revealed an enlarged uterus, but smaller than indicated by the time and somewhat harder than in a normal pregnancy. No swelling in fornices was felt. Tenderness was discovered on palpating the left iliac region. From the second month there had been much sickness, with abdominal pain on two occasions. At the fourth month there was another attack of pain with vomiting of blood and slight vaginal hæmorrhage. The patient was a very frail and slight, pale woman; her tongue was thickly coated and the skin gave off a nasty odour. Dr. R. J. Verco, in consultation, remarked on the hardness of the uterus, its lack of mobility and the lack of swelling in either fornix. The pulse rate was 96 and the temperature 37·2° C. (99° F.). There was a history of previous pelvic infection, with copious purulent discharge, but gonococci had never been found. The patient had been married three years and nine months and had had one pregnancy twelve months previously, which ended in a miscarriage at three months. The husband was informed that the condition suggested ectopic pregnancy, but as there was no swelling apart from the enlarged uterus, it was probably due to uterine pregnancy with pelvic infection. Unfortunately rupture of the sac involving the larger vessels of the uterine muscle took place before operation, when the abdomen was found full of blood, with the fœtus lying free. There was no bleeding from the tissues at operation, and the patient died two hours

later. The case was brought forward because of its extreme rarity.

Carcinoma of the Transverse Colon.

Dr. Duguid also showed a man, aged fifty-four years, from whom, on October 29, 1930, he had removed a ring carcinoma of the transverse colon, of unusual type, after proximal drainage eleven days earlier, carried out on account of complete obstruction. At the initial operation thickening of the pylorus and firmness of the head of the pancreas were noted, and enlarged glands were found in the vicinity of the growth. The bowel proximal to the mass was greatly inflamed and that distal to it was distended. There was a pinhead thickening on the ascending colon with inflammatory radiations running from it. Improvement in the condition after drainage was very marked, and wide excision followed. The patient returned to work after the Christmas holidays and had been in excellent health since.

The specimen and sections were also shown. Dr. Bull's report was as follows: "Sections show a carcinoma which has apparently arisen in an area of polyposis. Invasion of the deeper tissues of the wall has not gone very far, and one would judge that the malignancy is of low grade." In addition to an immediate history of increasing constipation of from six to seven months' duration, there was a history of attacks of vomiting extending over thirty years. There had been no such attack since operation.

NOMINATIONS AND ELECTIONS.

THE undermentioned has been nominated for election as a member of the New South Wales Branch of the British Medical Association:

Lawrance, Kenneth George, M.B., 1929 (Univ. Sydney), Coast Hospital, Little Bay.

Post-Graduate Work.

LECTURES IN MELBOURNE.

THE Melbourne Permanent Post-Graduate Committee has asked that readers be reminded of the post-graduate lectures to be delivered at the Medical Society Hall, Melbourne, on February 11, 12 and 15, 1932, by Mr. C. H. Fagge. The subjects of the lectures are:

1. General points. Appendicitis.
2. Gynæcological emergencies.
3. Obstruction.

The lectures will commence each evening at 8.30 o'clock. The fee for the course is two guineas. Mr. Fagge is a distinguished London surgeon, and medical practitioners are urged to avail themselves of the opportunity of hearing his lectures.

Correspondence.

STERILIZATION OF THE UNFIT.

SIR: After again reading your article and the two letters in the issue of December 26, 1931, one is forced to ask what all the fuss is about and why Dr. Grey Ewan should allude to the proposal as "atrocious"? That inexcusable word might better be applied to the counter proposal made by Dr. Ewan following a quotation from an English report in which it is suggested that "it would be a valuable safeguard if the marriage of defectives . . . could be prohibited by law".

All that would happen, and has happened, in such cases is known to all physicians in general practice. It leads to masturbation with its sequelæ, abortion, infanticide, venereal disease and crime in females and to all sorts of psychopathic relations between males. If this is not "atrocious" it is certainly the height of folly and demands an urgent remedy.

The assertion that "most of us believe . . . that mental defect is due to genetic variation so that . . . in every generation the recessives die out and the partials continue for ever . . ." is so contrary to my study of history that one would like to get the facts supporting such a statement.

The real question at issue is not "castration", but "sterilization", and is not so much a question of genetics, but of practical preventive medicine. An imbecile girl of twenty-two, in spite of the continued supervision of her mother and sister, at last becomes pregnant, and as I refuse "abortion" as an "atrocious" act in common with some other doctors, the baby is born. It is one of the "partials" probably. No one wants it, the mother least of all, and after many attempts ties a string around its neck and throws it in the water hole. It is then found she is again pregnant and so the "good work goes on".

I would like to ask Dr. Grey Ewan what remedy he has for such a case and if solitary confinement or what amounts to the same thing would be less "atrocious" than occluding her Fallopian tubes?

Yours, etc.,

J. F. MERRILLEES.

Alexandra, Victoria,
December 28, 1931.

AN ALLEGED ACTION OF ORALLY ADMINISTERED INSULIN.

SIR: Dr. Basil Corkill, in your journal of December 26, 1931, in a note on the above subject, says: "Since the discovery of insulin persistent attempts have been made to substitute oral for subcutaneous administration, but up to the present all such attempts have proved valueless."

In the following extract from an article of mine (*Medical Press*, February 11, 1931) on the lymphatic system and gland balance, some reason may be found for this failure.

> Biedl, in 1898 (*Internal Secretions*, 218-239), discovered that by tying the thoracic duct in an animal or by leading the cut end to the exterior, he produced experimental diabetes. The pupil also reacted to adrenalin locally applied.
>
> An injection of lymph from another animal prevented both the diabetes and the mydriatic reaction. Swale-Vincent and Schaffer agree that these results prove that the lymphatic system has a definite action on the carbohydrate content of the blood. What is that action? The withdrawal of the lymphatic content produced an immediate glycolysis. It is thus clearly evident that the lymphatic content definitely inhibited glycolysis. When the lymph stream was interrupted, glycolysis followed and an injection of lymph from another animal restored the carbohydrate blood balance.
>
> Thus the lymphatic antibody, by its inhibitory action, regulates the carbohydrate content of the blood.
>
> It is at once apparent that if this be so the comparative clinical failure of insulin exhibited orally or intravenously must necessarily follow and also the danger of an overdose of insulin in producing a total inhibition instead of the normal balance.

Insulin is the internal secretion of the pancreas injected subcutaneously and reaching the blood through the lymphatic system, which gives it its specific potency. Orally or intravenously, it necessarily is a failure.

Yours, etc.,

D. MONTGOMERIE PATON.

Kilmore, Victoria,
December 29, 1931.

Obituary.

DANIEL GILBERT MILLER TEAGUE.

WE regret to announce the death of Dr. Daniel Gilbert Miller Teague, which occurred on January 9, 1932, at Armadale, Victoria.

Books Received.

HEALTH IN HOT CLIMATES, by J. N. Dugdale, M.B., Ch.B.: Second Edition; 1931. London: John Bale, Sons and Danielsson. Crown 8vo., pp. 189. Price: 5s. 6d. net.

THE MIND IN ACTION: A STUDY OF MOTIVES AND VALUES, by A. C. Garnett, M.A., Litt.D.; 1931. London: Nisbet and Company. Demy 8vo., pp. 238. Price: 5s. net.

THE ESSENTIALS OF BACTERIOLOGICAL TECHNIQUE, by R. F. Hunwicke, B.Sc., A.I.C., with an introduction by W. G. Savage; 1931. London: Williams and Norgate. Demy 8vo., pp. 108, with illustrations. Price: 6s. 6d. net.

GENETIC PRINCIPLES IN MEDICINE AND SOCIAL SCIENCE, by Lancelot Hogben, M.A., D.Sc.; 1931. London: Williams and Norgate. Demy 8vo., pp. 230. Price: 15s. net.

TUMOURS OF THE BREAST, THEIR PATHOLOGY, SYMPTOMS, DIAGNOSIS AND TREATMENT, by Sir G. Lenthal Cheatle, K.C.B., C.V.O., F.R.C.S., and M. Cutler, B.Sc., M.D.; 1931. London: Edward Arnold. Royal 4to., pp. 604, with illustrations. Price: 50s. net.

Diary for the Month.

JAN. 27.—Victorian Branch, B.M.A.: Council.
FEB. 2.—New South Wales Branch: Organization and Science Committee.
FEB. 3.—Victorian Branch: Branch.
FEB. 9.—New South Wales Branch: Ethics Committee.
FEB. 16.—New South Wales Branch: Executive and Finance Committee.
FEB. 23.—New South Wales Branch: Medical Politics Committee.
FEB. 24.—Victorian Branch: Council.

Medical Appointments.

Dr. F. M. Burnet (B.M.A.) has been appointed to the staff of the National Institute for Medical Research at Hampstead, England.

* * *

Dr. A. Curtis (B.M.A.) has been appointed Acting Medical Superintendent of the Hospital for the Insane, Sunbury, Victoria, pursuant to the provisions of the *Lunacy Act*, 1928.

* * *

Dr. A. J. Turner (B.M.A.) and Dr. H. B. Ellerton have been appointed members of the Nurses and Masseurs Registration Board, Queensland, for a period of three years from January 1, 1932.

* * *

Dr. A. J. Kelsey (B.M.A.) has been appointed Government Medical Officer at Bowen, Queensland, and a Health Officer under *The Health Acts*, 1900 *to* 1931.

* * *

Dr. A. A. Lendon (B.M.A.) has been reappointed President of the Medical Board of South Australia.

* * *

Dr. W. Ray has been appointed Honorary Consultant Medical Officer at the Yatala Labour Prison and His Majesty's Gaol at Adelaide, South Australia.

* * *

Dr. E. D. E. E. O'Brien has been appointed Resident Medical Officer at the Adelaide Hospital, South Australia.

Medical Appointments Vacant, etc.

FOR announcements of medical appointments vacant, assistants, *locum tenentes* sought, etc., see "Advertiser," page xvi.

AUSTIN HOSPITAL FOR CHRONIC DISEASES, HEIDELBERG, VICTORIA: Honorary Anæsthetist.

COMMONWEALTH OF AUSTRALIA: Government Medical Officer, Nauru.

NEW SOUTH WALES MASONIC HOSPITAL: Visiting Consulting Urologist.

ROYAL HOSPITAL FOR WOMEN, PADDINGTON: Resident Medical Officer.

ROYAL NORTH SHORE HOSPITAL OF SYDNEY: Resident Medical Officer.

Medical Appointments: Important Notice.

MEDICAL practitioners are requested not to apply for any appointment referred to in the following table, without having first communicated with the Honorary Secretary of the Branch named in the first column, or with the Medical Secretary of the British Medical Association, Tavistock Square, London, W.C.1.

BRANCH.	APPOINTMENTS.
NEW SOUTH WALES: Honorary Secretary, 135, Macquarie Street, Sydney.	Australian Natives' Association. Ashfield and District United Friendly Societies' Dispensary. Balmain United Friendly Societies' Dispensary. Friendly Society Lodges at Casino. Leichhardt and Petersham United Friendly Societies' Dispensary. Manchester Unity Medical and Dispensing Institute, Oxford Street, Sydney. North Sydney Friendly Societies' Dispensary Limited. People's Prudential Assurance Company Limited. Phœnix Mutual Provident Society.
VICTORIAN: Honorary Secretary, Medical Society Hall, East Melbourne.	All Institutes or Medical Dispensaries. Australian Prudential Association, Proprietary, Limited. Mutual National Provident Club. National Provident Association. Hospital or other appointments outside Victoria.
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